The Roles of Nutrition Education and Food Vouchers in Improving Child Nutrition: Evidence from a Field Experiment in Ethiopia*

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Abstract

Mothers' lack of knowledge about child nutrition and limited resources lead to poor diets among children in developing countries, increasing their risk of chronic undernutrition. We implemented a cluster randomized control trial that randomly provides four-month-long Behavior Change Communication (BCC) and food vouchers in Ethiopia. We find improvements in child-feeding practices and a reduction in chronic child undernutrition only when BCC and vouchers are provided together. BCC or voucher alone had limited impacts. Our results highlight the importance of adding an effective educational component to existing transfer programs.

Keywords: infant and child nutrition, health information, behavior change communication, food vouchers, randomized control trial, Ethiopia

JEL classification: I12, I26, J22, O12, O15

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1. Introduction

In developing countries, nutritional status is a critical component of health, especially for children under the age of two (Schwarzenberg et al. 2018). Child undernutrition is linked to nearly half of all deaths in children under five and affects more than 150 million young children (World Bank 2017). Child undernutrition is also an important challenge for economic development because it leads to poorer health, education, and labor outcomes in adulthood (Black, Allen, et al. 2008; Hoddinott, Behrman, et al. 2013). These health and economic effects are long-term, spanning adulthood and even generations (Hoddinott, Maluccio, et al. 2008; Chakrabarti et al. 2021).

Drawing from the large literature on the causes of chronic child undernutrition, many interventions have focused on addressing a single cause of undernutrition such as micronutrient deficiencies (Muller et al. 2003; der Merwe et al. 2013), lack of knowledge (Fitzsimons et al. 2016), and lack of income (Manley et al. 2013), but often found limited impact. Moreover, it is estimated that the summed impact of ten single-dimensional nutrition-specific interventions, without accounting for complementarities, would reduce chronic child undernutrition by only 20% at nearly full coverage (Bhutta et al. 2013).

This modest impact could be due to the single-dimensional approach that most interventions take, despite the multifaceted and interdependent causes of undernutrition. To illustrate, nutrition education might have limited impact if low level of income hinders knowledge application. Also, impacts of transfer programs could be limited if lack of information is a binding constraint.

Despite the conceptual and instrumental importance of combining education with transfer programs, many do not have an educational component. In-kind and cash transfers, with improving nutritional status being one of their core aims, reach more than 1 billion people worldwide (Fiszbein et al. 2014; Alderman et al. 2018). Yet, the largest of such transfer programs including the Public Distribution System in India and the *Bolsa Familia* program in Brazil lack an effective educational component, even though its end goal is to improve diet quality (Alderman et al. 2018; Paes-Sousa et al. 2011). Moreover, nutrition-related messaging, where provided, is often delivered ineffectively, limiting its ability to affect behaviors

(Rivera et al. 2019). Therefore, given the evidence on the limited impact of transfers on child nutrition (Manley et al. 2013), it seems crucial to couple transfers with nutrition education, and to test its effectiveness against standalone programs.

In this paper, we study the roles of knowledge and affordability in changing mothers' child-feeding practices as well as child growth. To do so, we designed and implemented a community-based cluster randomized experiment in Ethiopia that provides nutrition education in the form of behavioral change communication (BCC) and food vouchers in collaboration with Africa Future Foundation (AFF), an international NGO focused on health and education programs in sub-Saharan Africa. Specifically, we randomly provided four-month-long BCC (*BCC*), voucher (*Voucher*), and both BCC and voucher (*BCC+Voucher*) interventions for mothers with one or more children between four and 20 months of age.

This age range is important because stunting prevalence increases rapidly after the first six months as shown in Figure A1, which is when complementary feeding should start and exclusive breastfeeding no longer meets the energy and nutrients needed for rapid child growth (WHO 2009). Thus, adopting appropriate complementary feeding during this transitional period is particularly crucial for preventing undernutrition (Black, Victora, et al. 2013).[1]

As pre-specified in the pre-analysis plan at AEA RCT Registry, our primary outcomes are nutritional knowledge and child-feeding practice measures, with child anthropometry measures being secondary outcomes (Han et al. 2017). One of the strengths of this study is that we examine comprehensive measures of nutritional intakes, food expenditures, and child growth. For example, we carefully measure dietary quality and quantity using various standard World Health Organization (WHO) measures and household expenditures, each examining different aspects of children's diets. We also take advantage of detailed administrative data on BCC participation and food voucher usage. In addition, we collect various anthropometry data to explore child growth results.

We find large impacts of *BCC+Voucher*, smaller impacts of *BCC*, and no impact of

[1] Appropriate complementary feeding means feeding children a diverse diet that meets the nutritional requirements. This entails feeding vitamin A-rich fruits and vegetables daily, in addition to a range of other fruits and vegetables. Meat, poultry, fish, or eggs also need to be consumed daily to ensure the intake of certain micronutrients critical for growth found only in animal source foods. In this regard, healthy food in this paper refers to these food groups (WHO 2010).

Voucher on child-feeding behaviors. Specifically, *BCC* improves maternal nutritional knowledge and child-feeding practices and increases purchase of more diverse food to a limited extent. However, these small changes did not translate into child growth improvements. As for the *Voucher* group, we find no effect on nutritional knowledge, child-feeding behaviors, and child growth. To the contrary, *BCC+Voucher* considerably augments the positive impacts on nutritional knowledge, child-feeding behaviors, and diversified food purchase. We also find evidence for stunting reduction in this group. The impacts are driven by the prevention of stunting among those who were at risk of stunting or healthy at baseline—i.e., above -2 SD in the HAZ distribution—rather than recovering stunted growth.

Our results render important policy implications. For social protection or nutrition programs aiming to reduce child undernutrition, providing both nutrition education and food voucher simultaneously could be more effective than single interventions. In addition, when implementing programs to address undernutrition, it may be best to target all infant and young children in the critical age range of 4 to 20 months regardless of baseline nutritional status, rather than targeting only the already undernourished children because *BCC+Voucher* is particularly effective in preventing stunting from occurring in this age range rather than reversing it.

This research contributes to broadly two strands of literature. First, we contribute to the growing literature on the effectiveness of multifaceted programs on addressing multiple causes of poverty simultaneously. Conceptually, implementing multiple interventions at once to address the same problem has either crowding-out, additive, or complementary effects. It is important to identify interventions that do not crowd-out each other and implement them together to maximize cost-effectiveness. Some existing RCT studies with factorial design show that a program that integrates a water, sanitation, and hygiene (WASH) intervention with nutrition supplements may not necessarily have complementary effects on diarrhea and child growth (Luby et al. 2018; Null et al. 2018). On the other hand, while not specifically on nutrition, an RCT study conducted in Tanzania finds complementarity between unconditional grants to schools and teacher incentives based on student performance (Mbiti et al. 2019). This suggests that whether a set of combined nutrition interventions have synergistic effects is an empirical question, which may vary by existing constraints and types of intervention. Existing experimental studies on BCC and transfers do not have a factorial design and thus are unable to test complementarity: for example, recent BCC experiments conducted in Bangladesh lack a BCC only arm (Hoddinott, I. Ahmed, et al. 2017; Hoddinott, A. Ahmed, et al. 2018; A. Ahmed et al. 2019). To our knowledge, this study is the first study to test complementarity between nutrition education and vouchers.

We also contribute to the empirical literature on the effects of stand-alone intervention programs on child-feeding practices and child nutrition such as nutrition education and income support. Our study is unique in that we can directly compare nutrition education and transfers in the same setting. On the effects of BCC, recent experimental studies conducted in Bangladesh and Burkina Faso have provided causal evidence on the effectiveness of nutrition education programs on improving nutritional knowledge among caregivers and neighbors, feeding practices, and nutritional outcomes (Fitzsimons et al. 2016; Hoddinott, A. Ahmed, et al. 2018; Hoddinott, I. Ahmed, et al. 2017; Olney et al. 2015; Zongrone et al. 2018). However, all of these programs except for Fitzsimons et al. (2016) were coupled with other programs such as transfers and agricultural interventions, which limits the ability to single out the effect of BCC. Our study adds to the literature by showing the extent to which a BCC-only intervention with a relatively short-term and cost-effective program could be effective.[2]

On the impacts of food vouchers, we find that food vouchers without any educational component has no effect on child nutrition. This is in line with a meta-analysis examining 21 papers on 17 programs which finds that cash transfers have a positive but small and not statistically significant impact on child height (Manley et al. 2013).

The remainder of this paper is organized as follows: Section 2 presents the study design and the interventions; Section 3 describes the data and sample characteristics; Section 4 presents the conceptual framework and the empirical methods; Section 5 presents the results; and we conclude in Section 6.

[2]Existing studies provide evidence on interventions that are long-term, mostly two years, which are often costly and difficult to implement at large scale (Fitzsimons et al. 2016; Hoddinott, A. Ahmed, et al. 2018; Hoddinott, I. Ahmed, et al. 2017; Olney et al. 2015; Zongrone et al. 2018). Also, there exist only associational studies on BCC in Ethiopia (Kim et al. 2016).

2. Study Design and the Interventions

2.1. Study Context

Ethiopia is one of the least developed countries in the world with GDP per capita in 2017 of US$768 and the second most populous country in sub-Saharan Africa (World Bank 2017). Ethiopia is an appropriate setting for this study with significant child nutrition challenges. The prevalence of stunting in Ethiopia, an indicator for chronic undernutrition, was 38% among children under five (Ethiopia DHS 2016). Stunting prevalence increases rapidly after the first six months: at the age of six months, 16% of children were stunted in Ethiopia but the corresponding number increases to 47% by 24 months (Ethiopia DHS 2016). Low dietary diversity is particularly striking among young children in Ethiopia, with only 7% of children aged 6-23 months meeting the minimum acceptable dietary standards (Ethiopia DHS 2016).

Our study area is Ejere district (woreda) located in the Oromia region of central Ethiopia, approximately 50 km west of the capital, Addis Ababa. Ejere is primarily a rural district which is further subdivided into three urban and 27 rural wards (kebeles). Ejere has a population of around 112,000 spread over these 30 wards, who are predominantly engaged in mixed crop-livestock farming at a small scale. Most farmers engage in traditional practices of rain-fed subsistence agriculture. In the Oromia region in which Ejere is located, stunting prevalence among children under 5 in the Oromia region is 37% and only 9% of children under 24 months meet the minimum acceptable dietary standards (Ethiopia DHS 2016).

2.2. Experimental Design

We implement a cluster randomized control trial that randomly provided nutrition BCC and food vouchers. Figure 1 summarizes the study design. The study area is three urban and three randomly selected rural wards out of 30 wards in Ejere (Figure A2). From these wards, we randomly selected 79 villages to be included in this study.[3] A total of 79 villages (garees)

[3]The six wards consisted of a total of 105 villages of which 79 villages were considered in this study as a part of a nested study design, and the remaining villages are considered in a separate study. Specifically, two intervention arms with a father BCC component—1) BCC for mother and father and 2) BCC for mother and father and vouchers—were excluded from this study because the focus of this paper is on BCC program for mothers as main caregivers. As specified in the pre-analysis plan, the excluded two arms are considered in a separate study that examines the roles of father involvement in child nutrition.

from these six wards in Ejere entered a lottery and were randomly selected into one of four arms: BCC only (*BCC*), vouchers only (*Voucher*), BCC and vouchers (*BCC+Voucher*), and the control group. Randomization was stratified by wards.

Through the census of the study area, we identified eligible mothers and children for this study. The eligibility criteria for the treatment and control groups is mothers with at least one child aged between 4 and 20 months living in the villages included in this study. We found a total of 641 eligible mother and child pairs, all of which were included in the study for the treatment and control groups. There are 101 (15), 96 (14), 154 (13), and 290 (37) mother and child pairs (villages) randomly assigned to the *BCC*, *Voucher*, *BCC+Voucher*, and control groups, respectively.[4]

2.3. Interventions

BCC. The BCC treatment was an interactive information intervention on infant and young child feeding (IYCF) complemented by various participatory learning methods including weekly sharing of mothers' experiences applying new IYCF activities, videos and visual aids, role-plays, and cooking sessions (Appendix B). The BCC intervention is designed as a 16-week-long educational program to cover all of the key topics in IYCF while maximizing cost-effectiveness. An overview of the BCC curriculum is provided in Table B1. The focus of the BCC sessions was on the need to increase dietary diversity of children aged 6-23 months, with an emphasis on animal source foods and vitamin A-rich fruits and vegetables, appropriate feeding amounts and frequency, and feeding and caregiving practices.

The BCC facilitators consisted of local female community workers who had been working in the community as AFF social workers for at least six months up to five years. Treated mothers living in the same village formed a group of seven to sixteen mothers to receive the BCC education. Each group had two designated facilitators—a leader and a helper. The lead facilitator taught the sessions and led discussions and role-plays, while the supporting

[4] We initially planned a larger sample size with a greater number of wards but ended up dropping dangerous wards in the initial phase of the study due to the political turmoil in the study area, during which more than 500 people are estimated to have been killed. See news report about the protest: https://www.theguardian.com/world/2016/oct/02/ethiopia-many-dead-anti-government-protest-religious-festival.

facilitator helped by encouraging discussion and assisting illiterate mothers. The sessions were conducted at the ward office or health posts. Throughout the study, two supervisors randomly visited the BCC sessions for quality control. The supervisors also made home visits to mothers who missed more than two consecutive sessions to encourage attendance. The BCC facilitators, supervisors, and the study team had weekly group meetings to discuss progress and challenges.

Food vouchers. The voucher treatment provided food vouchers of 200 ETB (approximately 10 USD) per month for four months to the household, which could be used at nearby markets. This amount is similar to the cash or food transfer amount of Ethiopia's Productive Safety Net Program which was set to be about 8.5 USD at the time of the program design (MOA 2014). Vouchers were given in denominations of 5, 10, and 20 ETB to facilitate small transactions, and were required to be redeemed within the expiration date (four weeks) noted in the voucher (Figure A3). Food vouchers were redeemable for any kind of food items sold at the market including cereals, roots and tubers, fruits, vegetables, legumes, meat and fish, milk products, eggs, oil, sugar, and spices. All of these food groups were available in the weekly markets including dried meat. However, fresh meat was not available in the market but were sold in separate butcher shops or obtained from own or neighbor's livestock. Food vouchers were distributed every four weeks at the nearest market or at the participant's household if not picked up from the market. At the first disbursement, voucher recipients were provided detailed instructions on how to use the vouchers.

To prevent fraudulent transactions or transfers, study participants were required to present household photo IDs, provided by the study team, to redeem the vouchers, which were cross-checked by the merchants with the unique household ID number and names on the vouchers. On all market days of the study period, AFF staff were stationed at the market to facilitate transactions, record voucher-based transactions, and reimburse merchants at the end of every market day.

3. Data

3.1. Data Sources

The primary data sources are: 1) census data including household demographic and socioeconomic information, 2) baseline and follow-up surveys, and 3) administrative data collected during the intervention including BCC attendance rates and voucher usage records. The timeline of the data collection and interventions is summarized in Figure A4.

AFF conducted a census of households in Ejere in May-September 2016, covering approximately 22,000 households. The census collected a variety of demographic, socioeconomic, and health variables such as the age of mother and children, marital status, education and employment, household asset, and birth history of the mother.

The baseline survey was conducted in April-August 2017 before the intervention program began. The follow-up survey was conducted upon program completion in December 2017-March 2018, about 6 months after the baseline survey. Both the baseline and the follow-up questionnaires include detailed information on IYCF knowledge and practices, child food consumption, household food expenditures, health, anthropometry, demographics, and socioeconomic information. The follow-up survey also has a section on mothers' experience with the program.

In addition, our research team collected administrative data on BCC attendance and voucher usage during the intervention. Administrative data show that mothers attended the BCC sessions regularly (74% attendance rate). On voucher usage, the voucher staff collected information on the type of food item, the quantity bought, and the amount spent using the vouchers. These data show that most of the voucher participants utilized the vouchers to buy food at least once (94%). Including the 6% of people who never use the vouchers, 88% of face value of the voucher had been redeemed (on average 175 out of 200 ETB). Conditional on voucher usage, 90% of voucher value were used (on average 179 out of 200 ETB).

3.2. Outcome Variables

The primary outcomes for this study are mother's IYCF knowledge scores and child dietary diversity score (CDDS). The mother's IYCF knowledge score is the percentage of questions answered correctly out of 34 questions (Figure A5). CDDS, an indicator of dietary quality, sums the number of distinct food groups consumed by the child in the past 24 hours.[5]

We also introduced other measures of child-feeding practices. Minimum acceptable diet, which consists of minimum dietary diversity and minimum meal, accounts for feeding frequency as well as diversity, and focuses on improvements in the lower tail of the distribution (WHO 2010).[6]

As secondary outcomes, we measure child anthropometry such as height-for-age Z scores (HAZ) and stunting as well as weight-for-height Z scores (WHZ) and wasting. We measured height and weight three times during each survey to minimize errors, and used the mean of the three measurements in the analysis. HAZ and WHZ are standardized Z scores relative to the WHO reference population. Stunting or wasting is a dummy variable equal to 1 if a child's HAZ or WHZ is 2 standard deviations (SDs) below the WHO reference population.[7]

Lastly, we collect household-level information. First, we calculate per capita weekly household food expenditure in the past seven days. Second, we construct a food consumption score (FCS) which measures household diet quality in terms of both energy and diversity

[5] This measure is based on seven different food groups: cereals, roots, and tubers; legumes, nuts, and seeds; dairy products; meat/poultry and fish; eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables (WHO 2010). Dietary diversity is a useful indicator for diet quality, as it is shown to be positively associated with mean micronutrient density adequacy (Working Group on Infant and Young Child Feeding Indicators, 2006).

[6] Minimum dietary diversity is a dummy variable indicating whether the child received food from 4 or more food group in the last 24 hours, and minimum meal frequency is a dummy variable for whether the child consumed minimum number of meals appropriate for the age (WHO 2010). Minimum dietary diversity is a proxy for adequate micronutrient density of foods. The four food groups should come from a list of seven food groups: grains, roots, and tubers; legumes and nuts; dairy products (milk yogurt, cheese); flesh foods (meat, fish, poultry, and liver/organ meat); eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables. Minimum meal frequency, a proxy for a child's energy requirements, examines the number of times children received foods other than breastmilk. The minimum number is specific to the age and breastfeeding status of the child (WHO 2010).

[7] In the anthropometry analysis, we dropped extreme outlier observations that are considered to be biologically implausible values based on WHO recommendations (WHO 2006). We dropped 19 and 26 observations at baseline and follow-up, respectively, where HAZ is less than -6.0 or greater than 6.0, and 18 observations at baseline and follow-up where WHZ is less than -5.0 or greater than 5.0. We also excluded 26 observations that recorded a loss of more than 3.0kg in weight or 3.0cm in height between baseline and follow-up.

(Weismann et al. 2009).[8] FCS less than or equal to 35 is considered having poor to borderline consumption (WFP 2008).

3.3. Sample Characteristics and Randomization Balance

Table 1 presents the summary statistics for the whole sample (Column 2), the control group (Column 3), and the difference between each treatment groups and the control group (Columns 4-6) and between treatment groups (Columns 7-9). Panels A, B, C, and D present mother, child, household, and village characteristics at baseline, respectively. Mothers in our sample are, on average, 28 years old, 77% are Oromos, 84% are Orthodox Christians, 77% are married, 57% have work, 49% are able to read, 48% are able to write, have about 4 years of schooling, and the mean mother IYCF knowledge score is 21.5 out of 32 (67%). Mean age of the eligible child is approximately 12 months, the mean CDDS is 2.4, only 13% met the minimum acceptable diet at baseline, the mean HAZ is -1.1 with a 27% stunting prevalence, and the mean WHZ is 0.13 with a 6.6% wasting prevalence. At the household level, 14% are female-headed, average household size is 4.5, have approximately 2.3 children, and 45% are from rural areas. Average total weekly food expenditure per capita are approximately 132 ETB, with FCS of 43. At the village level, 46% of the villages are rural and have 8 eligible households on average. Columns 4 to 9 confirm that the randomization was successful, with the sample well balanced across treatment and control groups at baseline.

As shown in Panel E, mothers' attrition rate at the follow-up survey is 8.4%. Table 1 shows no significant difference in attrition rates across intervention groups. The attrition rate of follow-up child anthropometry is 18.9%. It is significantly different between the *Voucher* and the *BCC+Voucher* groups (Column 9), but this comparison is not the main focus of our analysis on anthropometry.[9]

[8] The FCS is calculated by summing the number of days that the household consumed each of the eight food groups (staples, pulses, vegetables, fruit, meat and fish, milk and dairy, sugar and honey, oils and fats), multiplying the summed number of days by the food group's weighted frequencies, and summing these weighted scores across food groups.

[9] The difference between mother and child attrition rates is due to mothers not bringing their eligible child to the follow-up survey during which child anthropometry was measured.

4. Conceptual Framework and Methods

4.1 Conceptual Framework

To help understand the results, we develop a simple conceptual model where households optimize adult consumption (X) and child nutrition input choices (C_1 and C_2) given a child health production function and a budget constraint. For simplicity, we assume that each household has one mother and one child, and the mother chooses between staple food (C_1) and more nutritious food such as meat, fruits, and vegetables (C_2). Appendix C lays out the detailed model and the analytical proof.

We define a true child health production function—$H = C_1^{\gamma_1} C_2^{\gamma_2}$—where $\gamma_1 + \gamma_2 = 1$ and $\gamma_1 \leq \gamma_2$. Also, we define a perceived child health production function—$\hat{H} = C_1^{\delta_1} C_2^{\delta_2}$—where $\delta_1 + \delta_2 = 1$, $\delta_1 > \delta_2$, and $\delta_1 > \gamma_1$. The true and the perceived functions differ due to mother's misperception about the relationship between nutritional inputs and child health. In the absence of BCC, we assume that mothers optimize based on this perceived H' as follows:

$$\max_{X, C_1, C_2} U(X, H) = (1-\alpha) log(X) + \alpha(\delta_1 log(C_1) + \delta_2 log(C_2))$$

$$s.t. \;\; X + C_1 + C_2 = Y + V \tag{1}$$

where V denotes the voucher amount. Note that if there is no intervention, $V = 0$ holds; and $V > 0$ in the *Voucher* only case. α refers to the weight on the perceived child's health relative to the parents' food consumption.

To account for the effects of BCC, we hypothesize that the effects of BCC are two-folds: 1) mothers care relatively more about children's food consumption, substituting some adult consumption with child consumption, and 2) mothers gain knowledge on optimal child-feeding. The first effect is captured by adjusting the coefficient α in Equation (1) to β where $\alpha < \beta$. As for the second effect, mothers update prior belief about health production function coefficients, δ_1 and δ_2, to the true coefficients, γ_1 and γ_2, respectively—i.e., updating the perceived health production function, $\hat{H}$, to the true health production function, H. Combining these two effects, the optimization problem of the mother with BCC can be re-written as:

$$U(X,H) = (1-\beta)log(X) + \beta(\gamma_1 log(C_1) + \gamma_2 log(C_2))$$

$$s.t.\ \ X + C_1 + C_2 = Y + V \tag{2}$$

In the *BCC+Voucher* case, $V > 0$ holds, and $V = 0$ for the BCC only case. C_2^0, C_2^V, C_2^B, and C_2^{BV} denote child consumption of nutritious food in the control, $Voucher$, BCC, and $BCC + Voucher$ groups, respectively. Similarly, H^0, H^V, H^B, and H^{BV} denote child health outcomes in the control, $Voucher$, BCC, and $BCC + Voucher$ groups, respectively. Solving for C_2 and H in both optimization problems (1) and (2), we find that the effect of the interventions are: $C_2^0 < C_2^V \lesseqgtr C_2^B < C_2^{BV}$ and $H^0 < H^V \lesseqgtr H^B < H^{BV}$. The algebraic representations of optimal goods and outcomes in each case is summarized in Table C1.

Furthermore, this model suggests that there could be complementarity between BCC and vouchers in improving child-feeding practices and health outcomes, with the difference between the effect of *BCC+Voucher* and the sum of the effects of *BCC* and *Voucher* being positive: $\Delta C_2^{BV} - (\Delta C_2^B + \Delta C_2^V) > 0$ and $\Delta H^{BV} - (\Delta H^B + \Delta H^V) > 0$, where ΔC_2^{BV}, ΔC_2^B, and ΔC_2^V as the impact on child consumption of nutritious food in the $BCC + Voucher$, BCC, and $Voucher$ groups compared to control, respectively, and ΔH^{BV}, ΔH^B, and ΔH^V as the impact on child health outcomes in the $BCC + Voucher$, BCC, and $Voucher$ groups compared to control, respectively.

It follows that BCC and vouchers are complementary in improving both child-feeding practices and child health, driven by greater resource allocation to child consumption ($\alpha < \beta$) and improved nutritional knowledge ($\delta_2 < \gamma_2$). Appendix C further shows graphical representations and a numerical example of the optimal C_2 and H, which confirms that, in this model, *BCC+Voucher* has the largest impact on diet diversity and child health—greater than that of *BCC* and *Voucher* combined—with *BCC* having a moderate impact and *Voucher* having the smallest impact.

4.2 Methods

Our estimation strategy relies on the randomized design of the program, which provides a clean source of identification. Our preferred specification estimates the following equation:

$$y_{ijk1} = \beta_0 + \beta_1 BCC_{jk} + \beta_2 Voucher_{jk} + \beta_3 BCC\&Voucher_{jk} + \beta_4 y_{ijk0} + X_{ijk0}\gamma + \eta_k + \varepsilon_{ijk} \quad (3)$$

where y_{ijk1} is the outcome of interest for household i from village j in ward k at follow-up including mother's nutritional knowledge score and nutrition indicators such as CDDS and child anthropometry. BCC_{jk}, $Voucher_{ik}$, and $BCC\&Voucher_{jk}$ are dummy variables equal to one if the respondent was living in the *BCC*, *Voucher*, or the *BCC+Voucher* treatment villages, respectively, at baseline and zero otherwise. Hence, β_1, β_2, and β_3 represent the intent-to-treat estimators. y_{ijk0} is the outcome of interest at baseline. X_{ijk} is a control vector of baseline household i 's characteristics including demographic variables (mother's age, eligible child's age, marital status, household size, number of children, ethnicity, religion) and socioeconomic status (mother's literacy, years of schooling, employment status, and household assets). η_k is ward fixed effects, and ε_{ijk} is an error term clustered at the village level. For main outcomes, we also present results without the control vector as well as the results using the first-difference specification.[10]

To address the issue of small number of clusters, we use the wild-cluster bootstrap (Cameron et al. 2008) and randomization inference methods to obtain valid inference (Rosenbaum 2002). In order to account for multiple hypotheses testing (Christensen and Miguel 2018), we group child-feeding practice outcome measures into a domain and take an average standardized treatment effect (ASTE) for several outcome variables (Finkelstein et al. 2012; Kling et al. 2007). For example, for food consumption measures, we group the food groups emphasized during the BCC program into one domain and compute the z-score for each outcome in this domain. Then, we stack the household-level z-scores for all outcomes within this domain and estimate a single pooled regression equation, while clustering standard errors at both the village and the individual levels in order to compute the ASTE.

[10]Our main estimation uses Analysis of Covariance (ANCOVA) which entails controlling for the baseline value of the outcome variable. This approach could have large gains in power for outcome variables with high variability and low autocorrelation (McKenzie 2012).

5. Results

5.1. First Stage Outcomes

5.1.1 BCC Attendance and IYCF Knowledge

We first show whether the BCC treatment successfully improved IYCF knowledge. Table 2 presents the impacts on BCC attendance and mothers' IYCF knowledge. Columns 1 and 2 compares the overall BCC attendance rates between the treatment groups and the control group. Note that attendance rate for the *Voucher* group and the control group are zero as expected. On average, the *BCC* and the *BCC+Voucher* group have 73% and 75% attendance rates, respectively, and they are not statistically different from each other. Attendance rate and knowledge scores by IYCF topic are presented in Table A1.

In Columns 3 and 4, we find that being assigned to the BCC program led to significant knowledge gains: 0.48 SDs and 0.42 SDs for the *BCC* and the *BCC+Voucher* groups, respectively. This is comparable to other studies with longer intervention periods lasting up to two years (Hoddinott, I. Ahmed, et al. 2017; Olney et al. 2015). Hence, we show that a similar or greater impact on mothers' knowledge can be attained with a relatively short treatment length at least in the short run. However, receiving voucher alone has no such effect as expected. The coefficients for *BCC* and *BCC+Voucher* are similar, and the difference is not statistically significant, suggesting that receiving vouchers in addition to the BCC intervention does not further increase knowledge gains.

5.1.2 Voucher Redemption

We also show results on voucher redemption using administrative data (Table 3). Column 1 shows that both the *Voucher* and the *BCC+Voucher* groups spent, on average, 44 ETB worth of food vouchers per week, redeeming about 88% of the disbursed voucher amount. The total amount redeemed per week is not statistically different between the *Voucher* and the *BCC+Voucher* groups.

Columns 2-10 show that the food vouchers are spent on most food groups in similar amounts between *Voucher* and *BCC+Voucher*. While large amounts are spent on starchy staples and oils and fats, households allocate a third of their voucher spending on non-staple food including dairy products, eggs, fruits and vegetables, and nuts and legumes. This is consistent with the literature on income elasticity for nutrients suggesting that increased income leads to a preference for higher quality foods and more diversified non-staple diets (Bilal et al. 2013; Skoufias et al. 2011). Meat is not usually bought with vouchers, as they are usually not sold in the market but obtained from their own or neighbor's livestock. In addition, voucher redemption patterns over time are front-loaded in any given month except for the first month, and voucher redemption by food group change little over time (Figures A6 and A7).

5.2. Primary Outcomes: Child-feeding Practices

We now look at effects on mothers' child-feeding behaviors reflecting the quality and quantity of children's diets. It is worth noting that the results on children's dietary intake based on mothers' reports are subject to social desirability bias, recall errors, or Hawthorne effects. Nevertheless, the comparisons between treatment arms—e.g., *BCC* and *BCC+Voucher*—are unlikely to be biased because the difference between the two groups would negate the bias which both groups are susceptible to. The results on child-feeding practices and household expenditures do not reflect the contemporaneous impacts of the treatments on food consumption, as these outcomes were measured at the follow-up survey implemented after one month from intervention completion.

5.2.1 Child-feeding Practice Outcomes

Panels A and B of Figure 2 present descriptive illustration of CDDS at baseline and follow-up survey, respectively. It shows that there is a considerable improvement in the CDDS distribution for the *BCC+Voucher* group (Figure 2): Compared to the control group, the overall CDDS distribution of the *BCC+Voucher* group shifted rightward.

In regression results shown in Table 4, we confirm that improvements in child-feeding practices are largest for the *BCC+Voucher* group. The improvement is robust across all measures: an increase in CDDS by 0.59 food groups, about 12 to 17 percentage point increases in the proportion of children meeting the minimum acceptable diet, minimum diet diversity, and minimum meal frequency standards, and a 0.08 SD increase in average standardized treatment effect. For the *BCC* group, we find that the improvements in child-feeding practices are smaller than the *BCC+Voucher* group. We find an increase of 0.33 food groups in CDDS, a 6.4 percentage point increase in the proportion of children meeting the minimum acceptable diet, and a 0.03 SD increase in average standardized treatment effect. Among the *Voucher* group, we do not find any impact. The results are similar in the first difference specification as shown in Table A2.

The impacts of *BCC+Voucher* are relatively larger compared to the results from existing literature where the length of BCC or nutrition education is longer, and thus, difficult to implement at scale (Olney et al. 2015; Reinbott et al. 2016). For example, Olney et al. (2015) show that a two-year-long BCC program combined with agriculture input support and training increases the proportion of children meeting minimum dietary diversity by 12.6 percentage points, but do not report results on other child diet measures. A similar study that evaluates the impact of a nutrition education program coupled with agricultural intervention finds a 9.0 and 9.3 percentage point increase in the proportion of children meeting the minimum dietary diversity and the minimum acceptable diet standards, respectively, but no effect on CDDS (Reinbott et al. 2016).

We find that *BCC+Voucher* treatment is greater than the sum of the individual impacts of *BCC* and *Voucher* interventions. For example, this difference for CDDS is 0.252 ($= 0.589 - (0.332 + 0.005)$) food groups (Column 2 of Table 4) and for ASTE is 0.05 ($= 0.084 - (0.034 + 0.001)$) SD (Column 10). Although the difference in ASTE impact is relatively large, it is statistically significant at the 10% level in the main specification (Columns 9 and 10) and not significant in the first difference specification (Column 5 in Table A2).[11]

By examining child food consumption by food groups, we further explain that the greater improvements in diet quality in the *BCC+Voucher* group is driven by the consumption of animal source foods (Columns 1 to 3) and vitamin A-rich fruits and vegetables (Column 4), which are emphasized in the BCC program (Table 5). We present average stan-

[11] The confidence intervals for bootstrap p-values from complementarity tests show that our study is slightly underpowered to provide robust evidence on complementaries: the minimum detectable complementarity is 0.87 food groups which is not small given that the CDDS is on a scale of 0 to 7.

dardized treatment effects on these food groups in Column 5. Food groups in Columns 6 to 8 were not emphasized in the BCC program. Among children in the *BCC* and *BCC+Voucher* groups, we find significant increases in children's consumption of food groups that the BCC program highlighted as important sources of micronutrients needed for healthy child growth (Column 5). Similar to results on child-feeding practices, the impact size is larger in the *BCC+Voucher* group compared to the *BCC* group, although the difference is not statistically significant.

5.2.2 Additional Nutritional Outcomes

We present findings on other measures of children's diets in Table A3. We do not find significant changes in breastfeeding in any treatment group (Column 1). However, mothers in the *Voucher* and *BCC+Voucher* groups feed (semi-)solid food more frequently (Column 2) unlike the results on main child-feeding practices in Table 4. These findings suggest that income might be a binding constraint for optimal child-feeding practice: only when receiving the vouchers, mothers could increase the quantity of (semi-)solid food as recommended by BCC. Also, mothers in the *Voucher* and *BCC+Voucher* groups perceive that their children have better diet quality although there is little improvement in CDDS for the *Voucher* group. One explanation for this misperception may be that those in the *Voucher* group think dietary quality improvement primarily in terms of (semi-)solid food feeding frequency and not of diversity.

While our interventions focused on improving young children's diets, we also study *household-level* food consumption and expenditure after intervention completion. In Table A4, we find positive impacts of *BCC* and *BCC+Voucher* on FCS by 5.5 and 5.7, respectively, driven by the consumption of food groups highlighted in the BCC sessions.

Also, in Table A5, we find that the changes in expenditures driven by the interventions remain even after the intervention ended. Column 1 shows positive coefficients on total food expenditures, though not statistically significant. In Columns 2-11, we find that households in the *BCC+Voucher* group continued to spend significantly more on healthy non-staple food than *BCC*, *Voucher*, and the control groups (Column 6).

Furthermore, Table A5 shows that in the *Voucher* group all additional expenditure goes to meat, whereas that of *BCC+Voucher* is more evenly spread, suggesting that *BCC+Voucher* leads households to diversify overall household food expenditures.[12]

We posit two reasons why households could increase food consumption and expenditures even after the intervention. First, households may have consumed food stock remaining from previous months. Looking at detailed food voucher use records, non-perishable food such as staples and oils and fats account for more than half of the voucher purchases (Figure A7). Second, it is also possible that the reallocation of household income triggered by the interventions persisted after intervention completion due to increased nutritional knowledge. It is well-documented in the habit formation and food consumption literature that increases in previous food consumption significantly increase current food consumption (Daunfeldt et al. 2012; Naik and Moore 1996). However, we are not able to test which channel plays a more important role in our setting.

In summary, the results on child-feeding practices demonstrate that nutrition education alone or financial support alone could only lead to limited or no improvement in child nutrition. However, financial support combined with appropriate nutrition education could bring about much greater improvements. These findings are confirmed by various measures of child-feeding practices, food group analysis, and household consumption and expenditures.

5.3. Further Outcomes: Child Physical Growth

5.3.1 Impacts on Stunting and HAZ

Panels A of Figure 3 presents the distribution of HAZ scores across study arms at baseline (top, A1) and follow-up (bottom, A2). The red vertical line is the cutoff for stunting. An overall increase in stunting prevalence after the first six months (Figure A1) is also observed in the control group. Descriptive illustration shows that, without any treatment, the overall HAZ scores decreased over the 6-month-period between baseline and follow-up.

[12] While we do not find evidence on use of voucher on meat (Table 3), we find increased household and child meat consumption (Table A4 and Table 5) as well as household expenditure on meat in all three treatment groups (Table A5). This could be because markets in which vouchers could be used were not the primary sources of meat for most households. Households typically procure meat from their own or neighbor's livestock or butcher shops that are mostly outside the market. As vouchers were fungible means of exchange within the market, voucher recipient households would have saved the money that would otherwise be spent on food items sold in the voucher market to buy meat from other sources.

Average HAZ score decreased from -1.03 to -1.54 and stunting prevalence increased from 27% to 41% in the control group between baseline and follow-up. One notable finding is that there is a considerable improvement in the HAZ distribution for the *BCC+Voucher* group. In particular, compared to the control group, the lower half of the HAZ distribution shifted rightward for *BCC+Voucher*, suggesting effects on stunting prevalence. Descriptive statistics show that stunting prevalence remained constant from baseline to follow-up for the *BCC+Voucher* group (about 31% at baseline and follow-up), while it increased for all other groups.

Table 6 shows formal regression results confirming the findings from Figure 3 (Columns 1 and 2). Stunting prevalence significantly decreases by 9.5 percentage points among children in the *BCC+Voucher* group compared to the control group, and this result is robust across other specifications including the first difference regression model presented in Table A6.[13] However, we do not find evidence for stunting reduction in the *BCC* and *Voucher* groups. Furthermore, we find evidence for complementarity between the BCC and voucher interventions in stunting prevention. The bootstrap p-value for the test of equality between the summed impact of *BCC* and *Voucher* and the impact of *BCC+Voucher* is 0.025 (Column 2 of Table 6), and 0.027 in the first difference model (Column 1 of Table A6).[14]

However, we do not find statistically significant positive impacts of *BCC+Voucher* on the HAZ score, although the coefficient is relatively large and positive (Columns 3 and 4). This could be because the increase in HAZ is centered around the lower half of the distribution, rather than the overall distribution as shown in Figure 3. This is also in line with the large impact of *BCC+Voucher* on minimum acceptable diet in Section 5.2 (Table 4), a measure that also focuses on improvements in the lower half of the distribution.[15]

[13]The size of *BCC+Voucher*'s impact on child stunting is larger compared to the impact size of other single nutrition interventions, and comparable to effects of combined BCC and transfers treatment (7.8 percentage point stunting reduction) as shown in A. Ahmed et al. (2019).

[14]For further robustness check, we estimate the effects of *BCC+Voucher* on stunting prevalence using various possible stunting cutoffs ranging from -1.6 to -2.4 SD cutoff. Figure A8 shows that *BCC+Voucher* consistently has a negative effect on stunting across various stunting cutoffs, with more pronounced effects at and near the -2 SD cutoff. This affirms that the impact of *BCC+Voucher* on stunting reduction is robust, with minor differences in precision depending on the cutoff.

[15]We also conduct heterogeneity analysis to assess whether treatment impacts differ by various baseline household characteristics including IYCF knowledge score, CDDS, whether stunted, child age, child sex, prior exposure to nutrition education, whether new mother (first child), mother's level of schooling, and household wealth level (Figures A9 to A11).We test for heterogeneous treatment effects using the following

Mechanism. We implement further analysis to shed light on the mechanism through which *BCC+Voucher* decreases stunting prevalence in a relatively short time period. We show that this impact is driven by preventing infant and young children from falling into stunting status during their rapidly growing period. We first examine changes in stunting status over time by study arm (Figure A12). We categorize the sample into three groups based on baseline nutritional status: stunted (HAZ<-2), marginal (-2≤HAZ<-1), and normal (HAZ≥-1). Panels A, B, C, and D show the proportion of each category in the *BCC*, *Voucher*, *BCC+Voucher*, and control groups, respectively. In each panel, the first, second, and third columns present descriptives for the normal, marginal, and stunted groups at baseline, respectively. The control group descriptive statistics (Panel A) show that stunting status fluctuates over time by baseline stunting status. There is a high degree of variability in stunting status during this rapidly growing period, occurring naturally without any intervention. For example, in the control group, 23%, 48%, and 69% of children of normal, marginal, and stunted HAZ at baseline, respectively, were stunted in seven months. The corresponding numbers for the *BCC+Voucher* group are 11%, 33%, and 63% (Panel B), which implies that the biggest improvement in HAZ came from those who had normal or marginal HAZ at baseline.

A subgroup analysis by stunting status at baseline formally tests the findings in the descriptive analysis. It confirms that the decrease in stunting status among the *BCC+Voucher* group is driven mainly by those who were not stunted at baseline (Table A7 and Figure 4).[16] These findings suggest that *BCC+Voucher* prevented stunting from occurring, rather than reversing stunted growth. This underscores that, in IYCF programming, all children in the critical age of 4 to 20 months should be targeted regardless of baseline nutritional status. This is in line with existing evidence in the nutrition literature which highlights the

specification: $y_{ijk1} = \beta_0 + \beta_1 X_{ijk0} BCC_{jk} + \beta_2 X_{ijk0} Voucher_{jk} + \beta_3 X_{ijk0} BCC\&Voucher_{jk} + \beta_4 BCC_{jk} + \beta_5 Voucher_{jk} + \beta_6 BCC\&Voucher_{jk} + \beta_7 X_{ijk0} + \beta_8 y_{ijk0} + \varepsilon_{ijk}$. y_{ijk} is the outcome of interest for household i from village j and ward k. BCC_{jk}, $Voucher_{jk}$, and $BCC\&Voucher_{jk}$ are treatment indicators equal to one for treated villages, and X_{ijk0} is a dummy variable for the baseline characteristic of interest. Thus, the coefficients β_1, β_2, and β_3 on the interaction between the baseline characteristic dummy and the treatment variables represent the heterogeneous treatment effects. Standard errors are clustered at the village level, the unit of randomization. Overall, for the most part, we do not find statistically significant heterogeneous treatment effects by the baseline characteristics we examined.

[16]For those not stunted at baseline, stunting prevalence at follow-up was lower among children in the *BCC+Voucher* group (21%) than the control group (32%). However, for those stunted at baseline, stunting prevalence at follow-up was similar, with 63% and 68% in the *BCC+Voucher* and the control groups, respectively (Figure 4).

importance of prevention during a critical period (Ruel et al. 2008).

Next, it is worth noting that the null effect of *BCC+Voucher* on stunting among those stunted at baseline is unlikely to be a result of low effort in mothers' feeding behaviors. Table A8 shows that child-feeding practices among mothers of stunted children in the *BCC+Voucher* group have improved, reflecting that they also exert effort to improve child-feeding practices for their children. This suggests that it is difficult to improve the growth of children who are stunted at baseline, as there may be pre-existing conditions linked to stunting such as low birthweight, illness, or other factors that hinder optimal growth. This further underscores the importance of prevention at an early age.

Cost-Effectiveness Analysis. Given the effects of *BCC+Voucher* on stunting, we calculate the cost-effectiveness of this intervention. The total average cost of *BCC+Voucher* per household was US$76 (approximately US$15 per month). This is lower than other similar integrated nutrition programs.[17] The cost per case of stunting averted by *BCC+Voucher* was US$795 and cost per DALY was US$265 which is considered highly cost-effective in WHO standards (WHO 2014). Further details are discussed in Appendix D.

5.3.2 Impacts on Wasting and WHZ

Panels B of Figure 3 presents the distribution of WHZ scores across study arms at baseline (top, B1) and follow-up (bottom, B2). The red vertical line is the cutoff for wasting. Wasting prevalence is fairly constant over time in the control group—8.5% at baseline and 7.8% at follow-up—which is to be expected as wasting changes in atypical situations such as acute starvation or severe disease. Corresponding results from formal regressions are presented in Columns 5 to 8 of Table 6. We do not find distinct changes in distribution in Figure 3 and consistent impacts in Table 6. Even though we find a statistically significant increase in WHZ scores for the *BCC* group in our preferred specification (Column 8), this appears to be spurious because the coefficient negative and not statistically significant in the first difference specification (Table A6).

[17] For example, Rwanda's Gikuriro, an integrated nutrition program funded by the USAID and implemented by Catholic Relief Services, cost US$142 per household and find no effect on stunting (McIntosh and Zeitlin 2018).

We discuss several possible explanations for why *BCC+Voucher* decreases stunting but not wasting. First, one of the main difference between stunting and wasting is the level of prevalence. As wasting prevalence is lower (7.8% in the control group at follow-up) than that of stunting (41% in the control group at follow-up), we may not have sufficient power to detect changes in wasting prevalence.

Second, the varying effects of *BCC+Voucher* on HAZ and WHZ can be explained by the nutritional science and medical literature that explores the relationship between weight and height. This literature suggests that changes in weight have a lagged effect on height during a 6-month interval in early childhood (Richard et al. 2012). This means that nutrition interventions could increase WHZ first (as weight increases and height remains the same in the short run) and increase HAZ later while attenuating the increase in WHZ (as height increases after several months).[18] Hence, it could be that the shift from WHZ gain to HAZ gain had already occurred in the *BCC+Voucher* group at follow-up, which is a plausible scenario given that there were large dietary improvements in the *BCC+Voucher* group. However, more research is needed to determine the timing and intensities of nutrition interventions' impact on HAZ and WHZ growth.

In summary, we find evidence that chronic child undernutrition could be improved only when BCC and vouchers are provided together. This corresponds to the results on child-feeding practices in Section 5.2 in which we also find the greatest improvements in diet quality and quantity among children in the *BCC+Voucher* group.

6. Conclusion

Chronic undernutrition results in impaired brain development, low levels of education, and poor health and labor market attainment in adulthood (Hoddinott, Behrman, et al. 2013; Schwarzenberg et al. 2018). Many interventions that target a single dimension of causes of child undernutrition have often found limited effects. Combined interventions that address

[18] An observational study found that undernourished children needed to reach 85% WHZ before linear growth could resume (Walker and Golden, 1988). Other studies on young children in Malawi, Nepal, and Jamaica also find that WHZ gain in a given interval is highly correlated with HAZ gain in the following interval (Costello 1989; Maleta et al. 2003; Walker et al. 1996).

multidimensional and interrelated causes of undernutrition may be more effective for healthy child development. We test this by implementing a community-based cluster randomized experiment in Ethiopia that randomly provides IYCF education through a nutrition BCC and food vouchers to mothers of children aged between 4 and 20 months.

We find that providing nutrition education only (*BCC*) or voucher only (*Voucher*) has limited effects on improving child-feeding practices and growth. However, when provided education and voucher together, child-feeding practices were significantly improved. We also find that stunting prevalence decreases only among those assigned both nutrition education and voucher treatments (*BCC+Voucher*).

This impact is driven by the prevention of stunting rather than reversing it. These results are in line with our conceptual framework which predicts complementarity between BCC and voucher interventions in child feeding and child health, with the *BCC+Voucher* group having the greatest positive impact on child nutrition outcomes.

Our results confer important policy implications. First, for programs aiming to improve suboptimal health behaviors, it is crucial not only to identify the key constraints, but also to understand the underlying relationship between the constraints. If the key constraints are mutually constraining, an effective program will require a multifaceted approach that relaxes multiple constraints simultaneously. In our case, our empirical results support the complementary relationship between nutritional knowledge and income, and highlight the importance of adding an effective educational component to many existing transfers in the developing world.

Second, for social protection or nutrition programs aiming to reduce child undernutrition, it may be best to target infant and young children in the critical age range of 4 to 20 months, including those who are not undernourished, as *BCC+Voucher* is particularly effective in preventing stunting from occurring in this age range rather than reversing it.

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Figures and Tables

Figure 1: Study Design

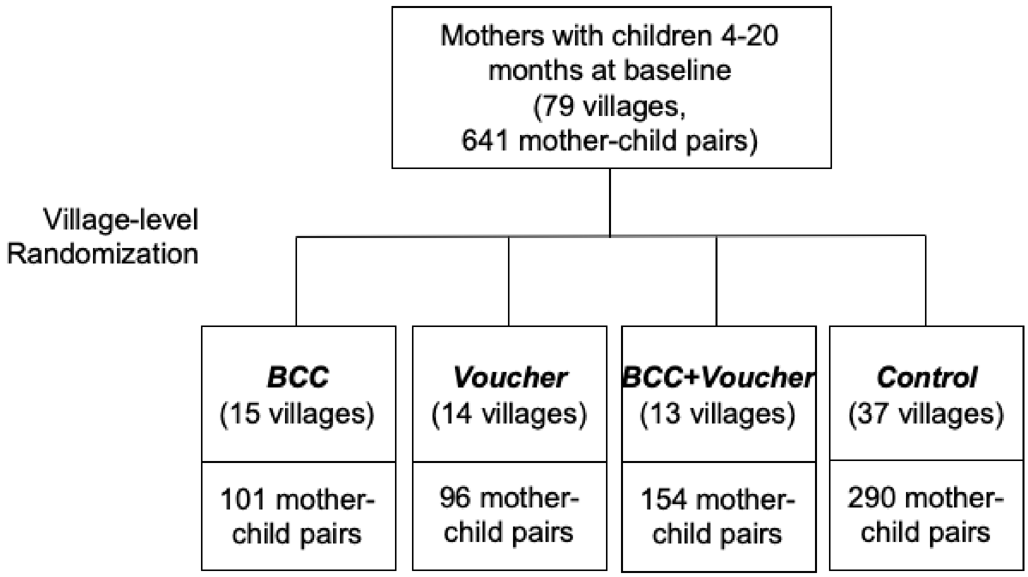
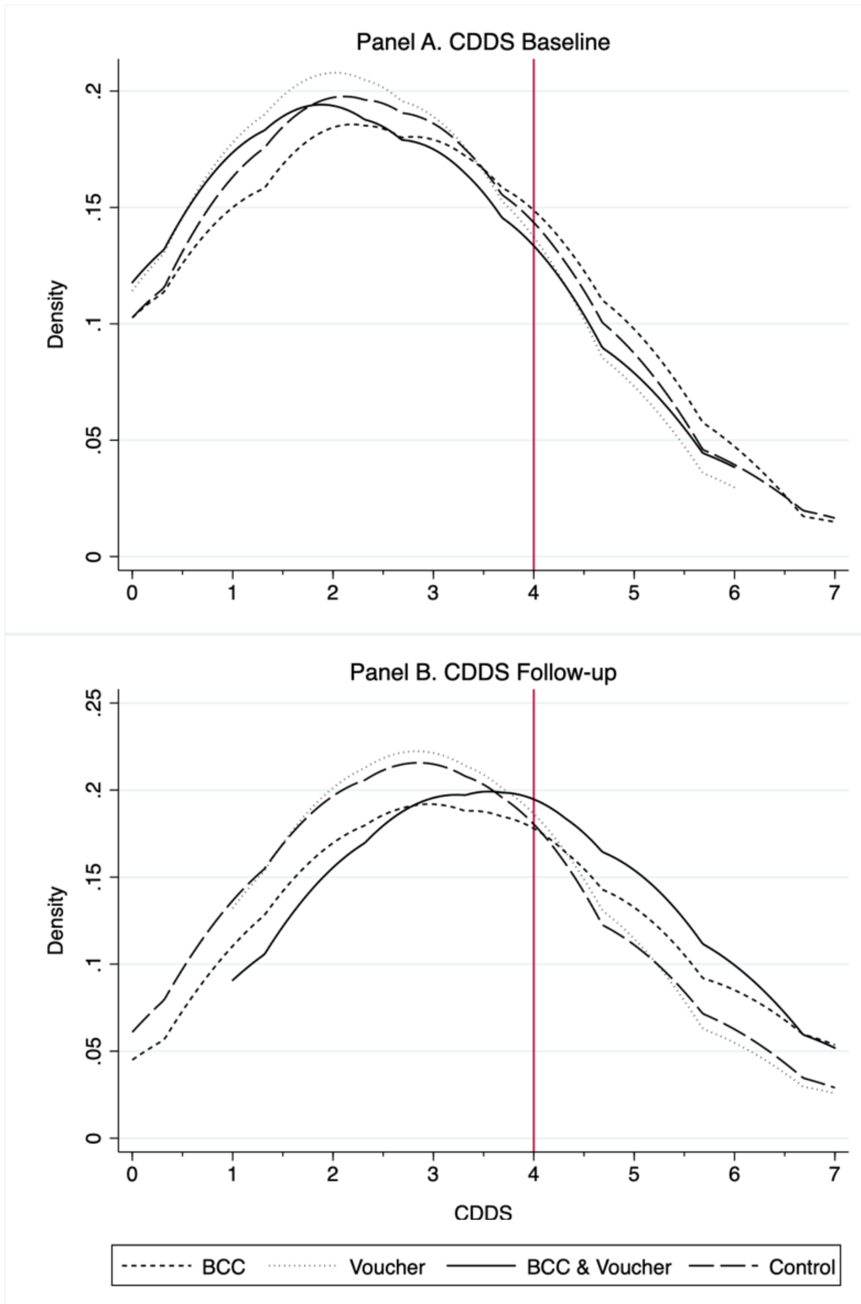
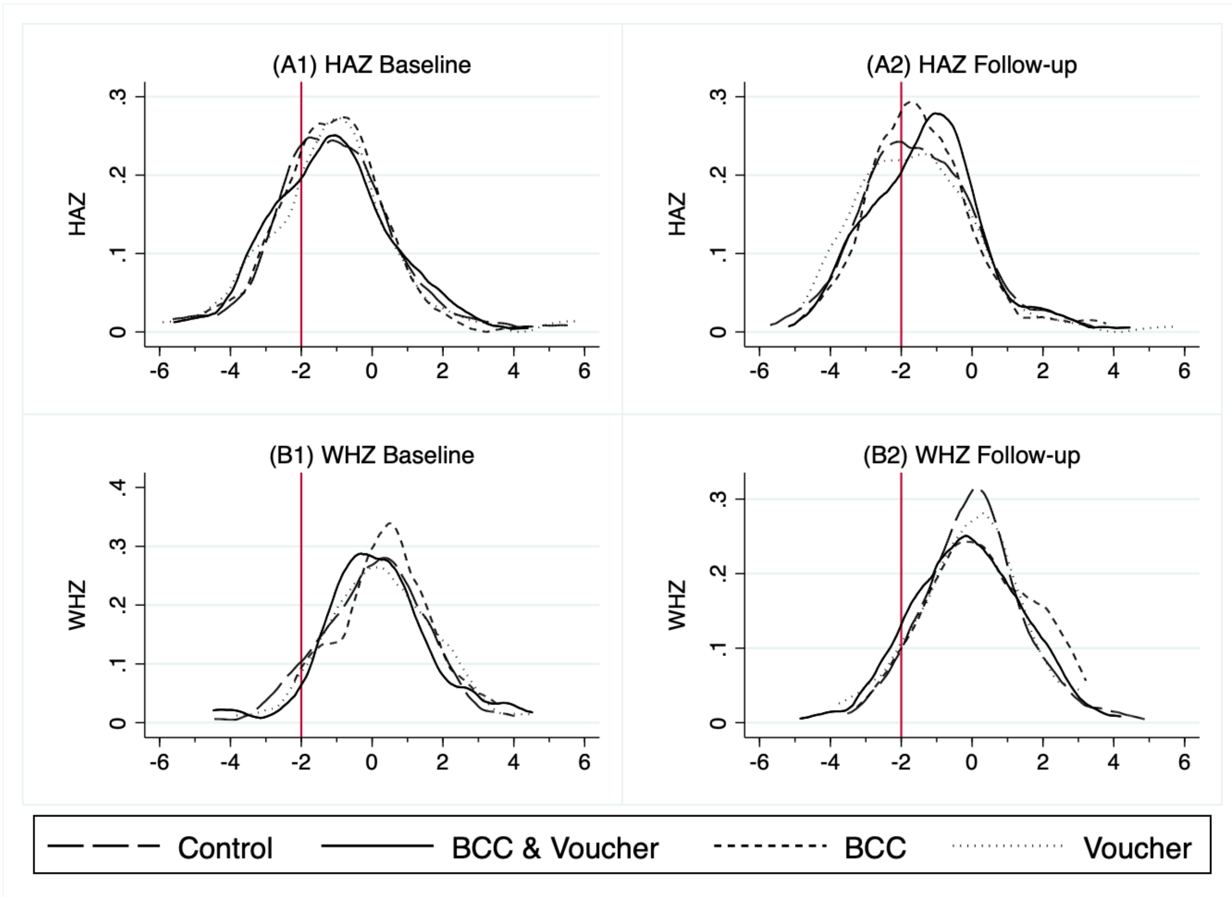


Figure 2: Distribution of CDDS at Baseline and Follow-up



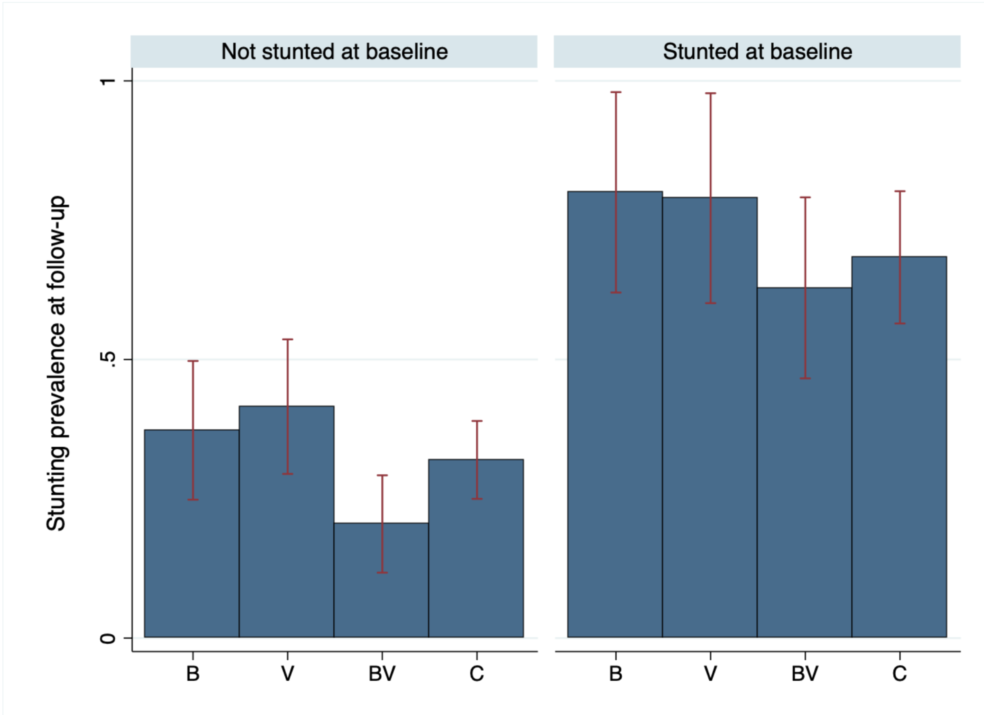
Note: This figure presents kernel density graphs of CDDS of eligible children at baseline (Panel A) and at follow-up (Panel B). The red vertical line represents 4 food groups, which is the threshold for meeting the WHO's minimum dietary diversity standard.

Figure 3: Distribution of Height-for-age Z Score (HAZ) and Weight-for-height Z Score (WHZ) at Baseline and Follow-up



Note: This figure presents kernel density graphs of height-for-age Z scores of eligible children at baseline (Panel A1) and at follow-up (Panel A2), and weight-for-height Z scores of eligible children at baseline (Panel B1) and at follow-up (Panel B2). The red vertical line represents -2 SD, below which means stunting for HAZ and wasting for WHZ, indicators for chronic undernutrition and acute undernutrition, respectively.

Figure 4: Stunting Prevalence at Follow-up by Stunting Status at Baseline



Note: The bar graphs represent mean stunting prevalence at follow-up by study arm conditional on whether stunted at baseline. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher, C=Control.

Table 1: Baseline Mean Characteristics by Intervention Groups

	N	Mean		Mean differences					
		All	Control	B-C	V-C	BV-C	B-V	B-BV	V-BV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Mother characteristics									
Mother age (years)	639	28.279	28.191	-0.656	-0.028	0.777	-0.684	-1.433	0.749
Mother is Oromo	641	0.766	0.766	-0.013	0.005	0.007	-0.018	-0.020	-0.002
Mother is Orthodox Christian	641	0.844	0.852	0.010	0.002	-0.040	0.007	0.050	0.042
Mother is married	640	0.769	0.779	-0.046	-0.049	0.020	0.004	-0.066	-0.070
Mother has work	641	0.565	0.545	0.049	0.039	0.027	0.011	0.023	0.012
Mother able to read	640	0.494	0.469	0.085	0.052	0.015	0.034	0.071	0.037
Mother able to write	640	0.484	0.455	0.089	0.055	0.028	0.034	0.061	0.027
Mother years of schooling	641	4.251	3.945	0.748	-0.216	0.919	0.964	-0.171	-1.134
Mother IYCF knowledge score	641	21.480	21.445	0.050	-0.132	0.198	0.183	-0.148	-0.330
Panel B. Child characteristics									
Eligible child age (months)	641	12.495	12.310	1.115	-0.029	0.053	1.144	1.062	-0.082
Child dietary diversity score	641	2.351	2.321	0.027	-0.219	-0.198	0.247	0.225	-0.022
Minimum acceptable diet	637	0.130	0.121	0.067	-0.007	-0.002	0.074	0.069	-0.005
Height-for-age Z (HAZ) score	617	-1.053	-0.992	-0.135	-0.019	-0.133	-0.116	0.017	0.133
Stunting	617	0.274	0.264	0.006	-0.019	-0.070	0.025	-0.045	-0.070
Weight-for-height Z (WHZ) score	617	0.129	0.011	0.328*	0.237	0.124	0.091	0.204	0.112
Wasting	617	0.066	0.094	-0.073**	-0.051	-0.032	-0.023	-0.041	-0.018
Panel C. Household characteristics									
Female household head	641	0.139	0.134	0.024	0.001	0.002	0.023	0.022	-0.001
Household size	641	4.541	4.500	-0.094	0.198	0.110	-0.292	-0.204	0.088
Number of children	641	2.351	2.321	-0.103	0.127	0.114	-0.230	-0.217	0.013
Asset index	641	-0.012	-0.051	0.178	-0.054	0.077	0.232	0.101	-0.131
Total weekly food expenditure, per capita	641	131.550	130.783	12.653	-9.367	0.734	22.020	11.919	-10.101
Household food consumption score	641	43.195	43.303	-1.076	0.144	0.164	-1.220	-1.240	-0.020
Panel D. Village characteristics									
Rural	79	0.456	0.460	0.007	-0.031	0.002	0.038	0.005	-0.033
Number of eligible households	79	8.114	7.838	-1.105	-0.981	4.008	-0.124	-5.113	-4.989
Panel E. Attrition									
Follow-up Survey Attrition Rates	641	0.084	0.093	0.006	-0.041	-0.015	0.047	0.021	-0.026
Anthropometry Attrition Rates	641	0.189	0.172	0.045	-0.037	0.061	0.082	-0.016	-0.098*

Note: This table reports mean of selected baseline variables. Columns 1-3 show the number of observations and a summary of the whole sample and the control group. Columns 4-9 report mean differences and significance levels from t-test of mean differences between study arms. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. B=BCC, V=Voucher, BV=BCC+Voucher.

Table 2: Effects on BCC Attendance and Mother IYCF Knowledge

	BCC Attendance rate		Mother IYCF knowledge score (standardized)	
	(1)	(2)	(3)	(4)
BCC (B)	0.725***	0.727***	0.452***	0.477***
	(0.023)	(0.022)	(0.107)	(0.097)
	[0.000]	[0.000]	[0.000]	[0.000]
	{0.000}	{0.000}	{0.000}	{0.000}
Voucher (V)	-0.001	-0.004	0.035	0.070
	(0.006)	(0.007)	(0.144)	(0.134)
	[0.909]	[0.527]	[0.820]	[0.607]
	{0.811}	{0.395}	{0.798}	{0.621}
BCC & Voucher (BV)	0.751***	0.754***	0.350***	0.419***
	(0.012)	(0.013)	(0.103)	(0.096)
	[0.000]	[0.000]	[0.003]	[0.000]
	{0.000}	{0.000}	{0.011}	{0.000}
Controls	No	Yes	No	Yes
Observations	640	637	587	584
R-squared	0.877	0.884	0.080	0.129
Control group mean	0.000		-0.166	
P-value: B=V	0.000	0.000	0.009	0.006
P-value: B=BV	0.337	0.304	0.404	0.601
P-value: V=BV	0.000	0.000	0.063	0.024
P-value: B+V=BV	0.333	0.268	0.497	0.482
Bootstrap p-value: B=V	0.000	0.000	0.023	0.018
Bootstrap p-value: B=BV	0.416	0.387	0.433	0.608
Bootstrap p-value: V=BV	0.000	0.000	0.073	0.036
Bootstrap p-value:B+V=BV	0.412	0.349	0.551	0.528
Bootstrap CI: B+V=BV	[-0.089, 0.034]	[-0.095, 0.032]	[-0.317, 0.572]	[-0.281, 0.539]

Note: This table reports results on BCC attendance rate and mothers' IYCF knowledge score (standardized). Columns 1-2 uses administrative data collected during intervention and compares BCC attendance rates with the control group where the control and the voucher group's attendance rates are zero. Estimations with and without a standard set of control variables are reported for each outcome. All estimations include ward fixed effects and columns 3-4 additionally controls for the baseline outcome. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The rows below control group mean report p-values and wild-cluster bootstrap p-values from F-tests of coefficient equality between treatment groups. The last row reports confidence interval of the bootstrap p-value from the complementarity test (B+V=BV). *** bootstrap $p<0.01$, ** bootstrap $p<0.05$, * bootstrap $p<0.1$.

Table 3: Effects on Voucher Redemption
(During Intervention)

	Average weekly total voucher exp.	Average voucher redemption per week by food group								
		Meat and fish	Milk and milk prod-ucts	Eggs	Vitamin A-rich fruits & veg.	Other fruits and veg.	Nuts and legumes	Starchy staples	Oil and fats	Sugar, drinks, and spices
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Voucher (V)	44.046***	0.142	0.078**	1.406**	1.206***	5.989***	1.978***	17.844***	12.029***	3.327***
	(1.130)	(0.091)	(0.040)	(0.276)	(0.134)	(0.439)	(0.418)	(0.922)	(0.862)	(0.256)
	[0.000]	[0.014]	[0.038]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
	{0.000}	{0.024}	{0.007}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}	{0.000}
BCC & Voucher (BV)	44.348***	0.031	0.121**	1.130***	1.424***	7.834***	1.499***	16.101***	11.633***	3.493***
	(0.892)	(0.027)	(0.046)	(0.166)	(0.142)	(0.433)	(0.448)	(0.711)	(0.552)	(0.196)
	[0.000]	[0.286]	[0.042]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
	{0.000}	{0.240}	{0.019}	{0.003}	{0.000}	{0.000}	{0.002}	{0.000}	{0.000}	{0.000}
Observations	524	524	524	524	524	524	524	524	524	524
R-squared	0.926	0.071	0.033	0.260	0.391	0.622	0.317	0.673	0.656	0.430
P-value: V=BV	0.815	0.272	0.452	0.327	0.229	0.008	0.404	0.207	1.000	0.501
Boot. p-value: V=BV	0.680	0.312	0.505	0.410	0.324	0.018	0.453	0.167	0.731	0.634

Note: This table reports effects on voucher redemption using administrative data collected during the intervention. The results compare the $BCC + Voucher$ group and the $Voucher$ group with the control group. The voucher redemption amount of the control group are zero as they did not receive vouchers, and the BCC group is not included in this analysis. All estimations include a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last two rows reports p-value and bootstrap p-value from an F-test of coefficient equality between $Voucher$ and $BCC + Voucher$ groups. *** bootstrap p<0.01, ** bootstrap p<0.05, * bootstrap p<0.1.

Table 4: Effects on Child-feeding Practices

	CDDS		Minimum acceptable diet		Minimum dietary diversity		Minimum meal frequency		ASTE	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
BCC (B)	0.315*	0.332*	0.052	0.064	0.035	0.046	0.022	0.035	0.029	0.034
	(0.172)	(0.172)	(0.035)	(0.035)	(0.053)	(0.053)	(0.068)	(0.069)	(0.019)	(0.018)
	[0.096]	[0.083]	[0.179]	[0.100]	[0.552]	[0.407]	[0.744]	[0.620]	[0.153]	[0.113]
	{0.098}	{0.063}	{0.183}	{0.065}	{0.555}	{0.402}	{0.748}	{0.583}	{0.154}	{0.092}
Voucher (V)	-0.032	0.005	-0.008	0.003	-0.053	-0.036	0.030	0.044	-0.007	0.001
	(0.190)	(0.185)	(0.034)	(0.033)	(0.054)	(0.051)	(0.046)	(0.044)	(0.019)	(0.018)
	[0.880]	[0.978]	[0.834]	[0.929]	[0.364]	[0.516]	[0.535]	[0.320]	[0.980]	[0.980]
	{0.864}	{0.981}	{0.820}	{0.946}	{0.384}	{0.543}	{0.617}	{0.436}	{0.734}	{0.980}
BCC & Voucher	0.554**	0.589**	0.134**	0.145***	0.158**	0.167**	0.097	0.116*	0.077***	0.084***
(BV)	(0.160)	(0.167)	(0.035)	(0.033)	(0.044)	(0.047)	(0.063)	(0.061)	(0.019)	(0.018)
	[0.012]	[0.015]	[0.012]	[0.004]	[0.016]	[0.015]	[0.175]	[0.093]	[0.003]	[0.001]
	{0.011}	{0.011}	{0.005}	{0.002}	{0.018}	{0.016}	{0.218}	{0.153}	{0.000}	{0.000}
Controls	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Observations	586	583	583	580	586	583	583	580	2,338	2,326
R-squared	0.103	0.121	0.085	0.117	0.099	0.123	0.021	0.042	0.053	0.068
Control group mean	3.073		0.126		0.328		0.534		0.000	
P-value: B=V	0.105	0.117	0.126	0.122	0.146	0.140	0.897	0.897	0.086	0.088
P-value: B=BV	0.198	0.186	0.055	0.049	0.029	0.038	0.355	0.328	0.027	0.022
P-value: V=BV	0.006	0.006	0.001	0.001	0.000	0.001	0.293	0.240	0.000	0.000
P-value: B+V=BV	0.312	0.353	0.110	0.155	0.032	0.057	0.642	0.705	0.057	0.082
Boot. p-value: B=V	0.128	0.133	0.149	0.125	0.164	0.150	0.902	0.900	0.114	0.122
Boot. p-value: B=BV	0.221	0.207	0.083	0.066	0.059	0.058	0.393	0.365	0.060	0.041
Boot. p-value: V=BV	0.010	0.013	0.005	0.003	0.000	0.001	0.325	0.281	0.001	0.000
Boot. p-value: B+V=BV	0.326	0.381	0.147	0.185	0.046	0.063	0.662	0.714	0.082	0.116
Boot. CI: B+V=BV	[-0.867, 0.332]	[-0.871, 0.349]	[-0.210, 0.032]	[-0.196, 0.040]	[-0.349, -0.003]	[-0.333, 0.011]	[-0.262, 0.186]	[-0.252, 0.187]	[-0.115, 0.007]	[-0.112, 0.014]

Note: This table reports results on child dietary diversity score (CDDS), minimum acceptable diet standard, minimum dietary diversity, and minimum meal frequency, collected after intervention completion (see section 3.2 for outcome definition). Columns 9-10 reports average standardized treatment effect (ASTE) across all outcomes in columns 1-8. Estimations with and without a standard set of control variables are reported for each outcome. All estimations include the baseline outcome and ward fixed effects. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The rows below control group mean report p-values and bootstrap p-values from F-tests of coefficient equality between treatment groups. The last row reports confidence interval of the bootstrap p-value from the complementarity test (B+V=BV). *** bootstrap p<0.01, ** bootstrap p<0.05, * bootstrap p<0.1.

Table 5: Effects on Child Food Consumption

	Whether child ate in the last 24 hours:							
	BCC-emphasized food groups					Not emphasized		
	Meat	Milk	Eggs	Vitamin A-rich fruits & veg.	ASTE	Other fruits & veg.	Nuts & legumes	Starchy staples
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BCC (B)	0.135**	0.083	0.078	-0.001	0.043**	-0.019	0.075	-0.023
	(0.051)	(0.046)	(0.063)	(0.055)	(0.018)	(0.059)	(0.056)	(0.017)
	[0.030]	[0.102]	[0.296]	[0.988]	[0.042]	[0.797]	[0.182]	[0.218]
	{0.001}	{0.115}	{0.174}	{0.978}	{0.019}	{0.750}	{0.231}	{0.059}
Voucher (V)	0.137***	-0.032	-0.019	-0.062	0.006	-0.038	0.022	-0.003
	(0.037)	(0.046)	(0.070)	(0.041)	(0.016)	(0.053)	(0.069)	(0.013)
	[0.003]	[0.513]	[0.791]	[0.145]	[0.760]	[0.506]	[0.775]	[0.881]
	{0.000}	{0.539}	{0.776}	{0.221}	{0.735}	{0.530}	{0.778}	{0.835}
BCC & Voucher	0.123***	0.092*	0.183**	0.096	0.070***	0.007	0.074	0.005
(BV)	(0.023)	(0.043)	(0.052)	(0.048)	(0.016)	(0.044)	(0.046)	(0.009)
	[0.000]	[0.058]	[0.014]	[0.100]	[0.002]	[0.884]	[0.149]	[0.680]
	{0.000}	{0.103}	{0.009}	{0.085}	{0.000}	{0.900}	{0.273}	{0.635}
Observations	583	583	583	583	2,332	583	583	583
R-squared	0.107	0.091	0.095	0.059	0.059	0.042	0.047	0.037
Control mean	0.118	0.279	0.286	0.225	0.000	0.805	0.367	0.992
P-value: B=V	0.981	0.029	0.242	0.296	0.074	0.769	0.467	0.248
P-value: B=BV	0.813	0.852	0.139	0.128	0.191	0.687	0.995	0.123
P-value: V=BV	0.735	0.016	0.013	0.003	0.001	0.414	0.444	0.563
P-value: B+V=BV	0.023	0.549	0.233	0.038	0.414	0.452	0.806	0.187
Boot. p-value: B=V	0.989	0.038	0.283	0.355	0.113	0.783	0.496	0.308
Boot. p-value: B=BV	0.816	0.846	0.181	0.186	0.262	0.724	0.998	0.196
Boot. p-value: V=BV	0.742	0.019	0.041	0.010	0.005	0.457	0.486	0.656
Boot. p-value: B+V=BV	0.052	0.585	0.269	0.065	0.467	0.485	0.804	0.255
Boot. CI: B+V=BV	[-0.004, 0.285]	[-0.194, 0.105]	[-0.350, 0.099]	[-0.327, 0.014]	[-0.082, 0.037]	[-0.265, 0.133]	[-0.172, 0.223]	[-0.086, 0.021]

Note: This table reports results on child food consumption by food group. All outcomes except Column 5 are dummy variables indicating whether the eligible child ate any food item in the respective food group in the last 24 hours, collected after intervention completion. The BCC program emphasized the importance of feeding animal products (Columns 1 to 3) and vitamin A-rich fruits and vegetables (Column 4). We present average standardized treatment effects (ASTE) on these food groups in Column 5. Food groups in Columns 6 to 8 were not emphasized in the BCC program. All estimations control for the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The rows below control group mean report p-values and bootstrap p-values from F-tests of coefficient equality between treatment groups. The last row reports confidence interval of the bootstrap p-value from the complementarity test (B+V=BV). *** bootstrap p<0.01, ** bootstrap p<0.05, * bootstrap p<0.1.

Table 6: Effects on Child Physical Growth

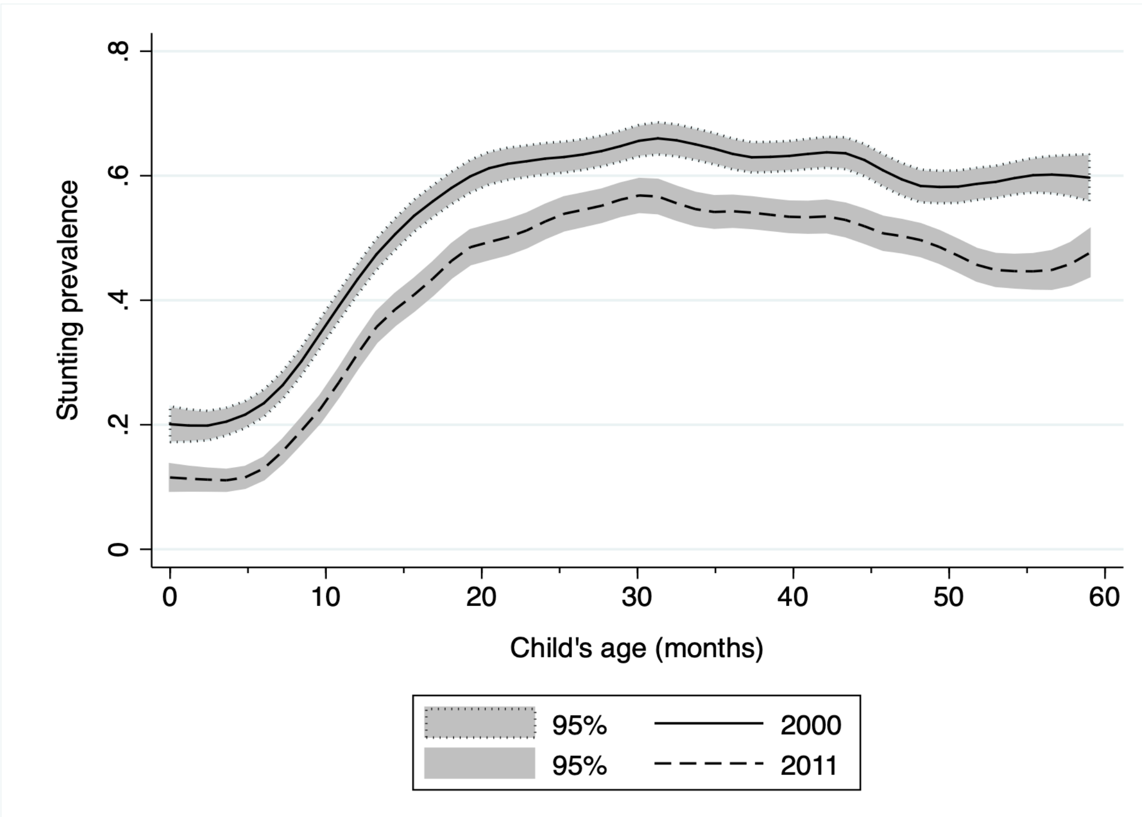
	Stunted		HAZ		Wasted		WHZ	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BCC (B)	0.085	0.084	-0.071	-0.035	-0.003	-0.012	0.188	0.239*
	(0.066)	(0.066)	(0.179)	(0.172)	(0.034)	(0.033)	(0.138)	(0.137)
	[0.225]	[0.226]	[0.721]	[0.841]	[0.934]	[0.744]	[0.182]	[0.092]
	{0.164}	{0.172}	{0.706}	{0.855}	{0.927}	{0.735}	{0.309}	{0.195}
Voucher (V)	0.078	0.058	-0.227	-0.172	0.039	0.024	-0.180	-0.149
	(0.060)	(0.063)	(0.160)	(0.162)	(0.036)	(0.036)	(0.159)	(0.160)
	[0.274]	[0.415]	[0.211]	[0.332]	[0.350]	[0.551]	[0.316]	[0.400]
	{0.194}	{0.329}	{0.232}	{0.332}	{0.296}	{0.520}	{0.374}	{0.458}
BCC & Voucher (BV)	-0.083	-0.095*	0.147	0.205	0.041	0.032	-0.210	-0.155
	(0.044)	(0.044)	(0.155)	(0.160)	(0.028)	(0.029)	(0.168)	(0.172)
	[0.140]	[0.099]	[0.458]	[0.335]	[0.151]	[0.273]	[0.273]	[0.439]
	{0.179}	{0.143}	{0.469}	{0.317}	{0.266}	{0.377}	{0.335}	{0.464}
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	487	486	487	486	482	481	482	481
R-squared	0.206	0.219	0.275	0.286	0.012	0.042	0.029	0.078
Control group mean	0.414		-1.535		0.078		0.048	
P-value: B=V	0.928	0.748	0.429	0.471	0.328	0.415	0.025	0.020
P-value: B=BV	0.013	0.010	0.225	0.186	0.244	0.269	0.017	0.030
P-value: V=BV	0.014	0.024	0.040	0.040	0.959	0.835	0.866	0.976
P-value: B+V=BV	0.008	0.014	0.072	0.096	0.924	0.704	0.319	0.318
Boot. p-value: B=V	0.943	0.785	0.484	0.527	0.361	0.435	0.044	0.029
Boot. p-value: B=BV	0.041	0.039	0.264	0.245	0.262	0.281	0.028	0.045
Boot. p-value: V=BV	0.054	0.074	0.081	0.100	0.958	0.839	0.894	0.977
Boot. p-value: B+V=BV	0.025	0.033	0.106	0.127	0.919	0.700	0.351	0.363
Boot. CI: B+V=BV	[0.037, 0.439]	[0.018, 0.443]	[-0.946, 0.099]	[-0.914, 0.129]	[-0.113, 0.102]	[-0.133, 0.090]	[-0.270, 0.699]	[-0.292, 0.802]

Note: This table reports results on stunting prevalence, height-for-age Z scores (HAZ), wasting prevalence, and weight-for-height Z scores (WHZ), collected after intervention completion (see section 4.2 for outcome definition). Estimations with and without a standard set of control variables are reported for each outcome. All estimations include the baseline outcome and ward fixed effects. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The rows below control group mean report p-values and bootstrap p-values from F-tests of coefficient equality between treatment groups. The last row reports confidence interval of the bootstrap p-value from the complementarity test (B+V=BV). *** bootstrap p<0.01, ** bootstrap p<0.05, * bootstrap p<0.1.

Appendices

Appendix A Figures and Tables

Figure A1: Stunting Prevalence by Child Age in Ethiopia



Source: Local polynomial smoothing predictions with 95% confidence intervals estimated using the DHS data (Ethiopia DHS, 2000, 2011).

Figure A2: Map of Ejere District

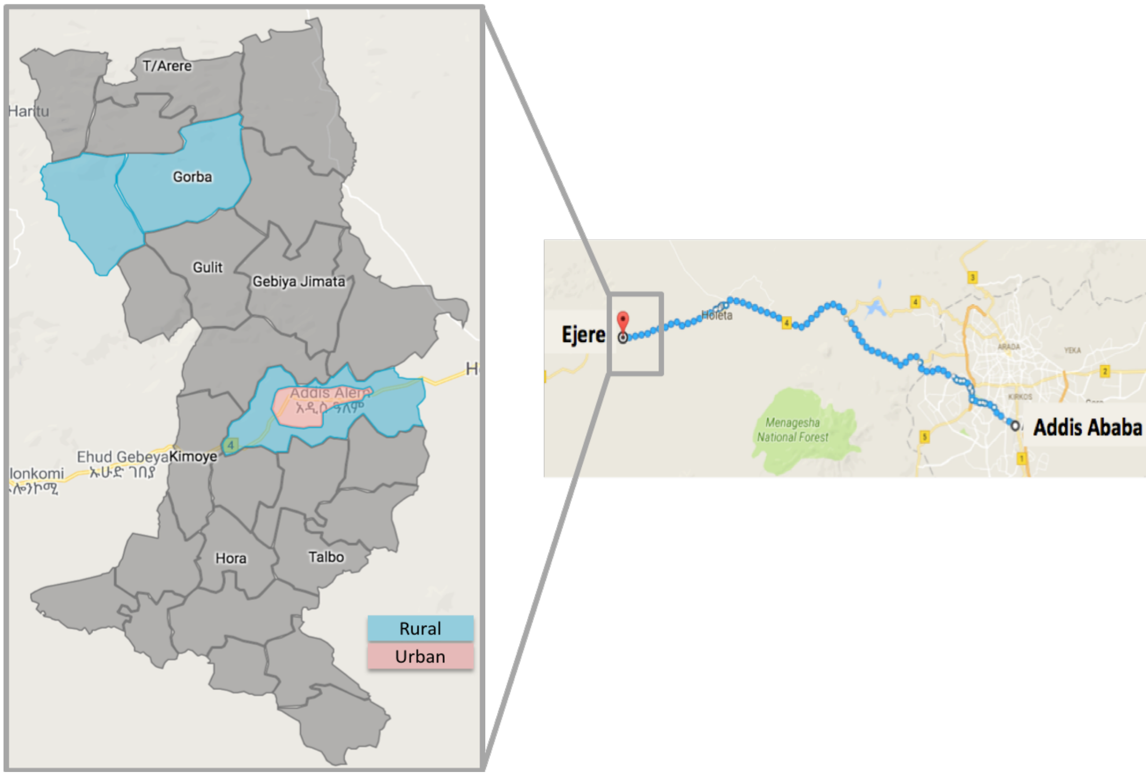
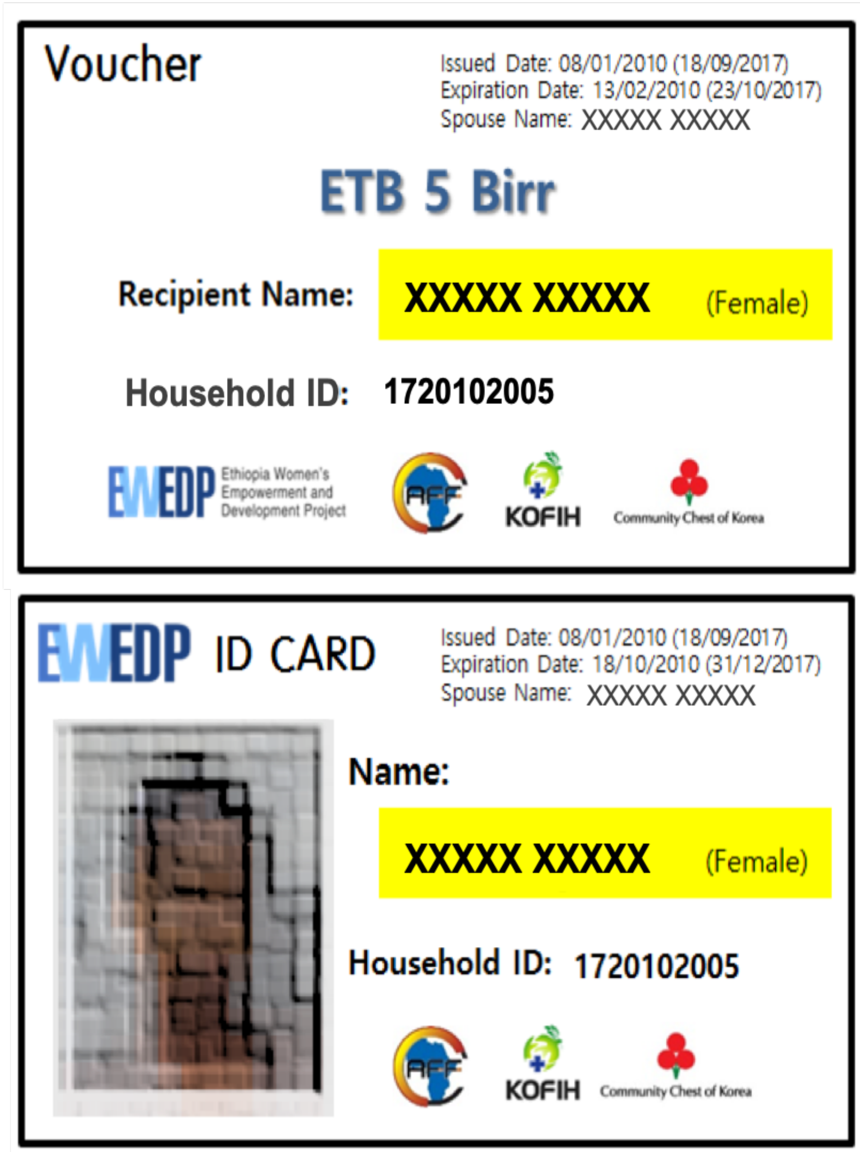


Figure A3: Sample Voucher and Household ID



Note: This figure shows sample voucher and household ID provided to the $Voucher$ and $BCC+Voucher$ households. Each voucher and the household ID state the recipient name, unique household ID, and spouse name which are cross-checked for verification in voucher transactions. They also list the issued date and expiration date in Ethiopian calendar, with dates in Gregorian calendar in parentheses. Before distribution, these vouchers and ID cards were printed and stamped in blue with an official AFF mark to prevent duplication.

Figure A4: Study Timeline

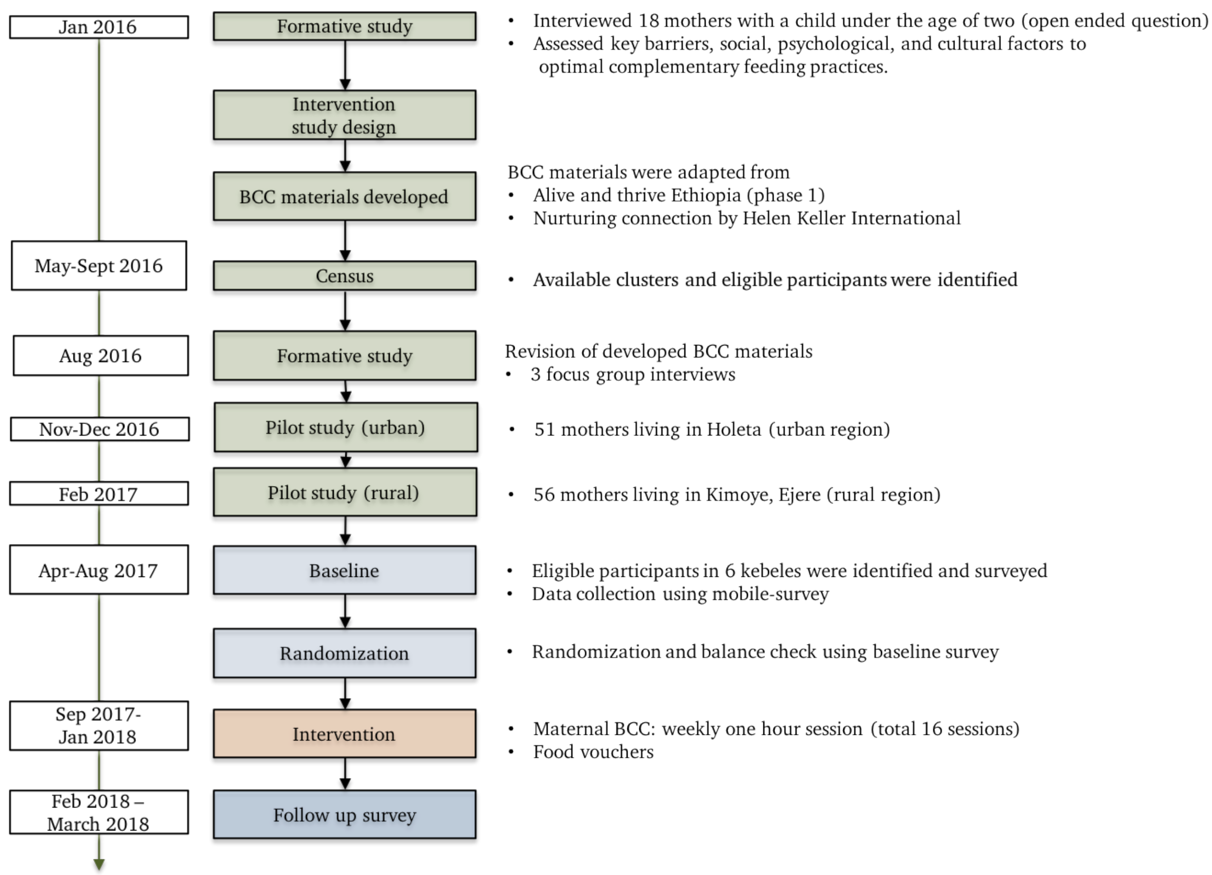


Figure A5: Mother IYCF Knowledge Questionnaires

1. At what age should a baby first start to receive foods (such as porridge) in addition to breast milk? 99=Don't know 88=cannot remember	_________month

	2. Please tell me if the following statement is true or false. If you don't know, say don't know.			
	Statements	True	False	Don't know
a	If a child does not eat enough iron, brain development will be delayed.	X		
b	If a child does not eat enough iron, children will become anemic.	X		
c	Vegetables and fruits are the best source of iron.		X	
d	Zinc helps to prevent illness such as diarrhea.	X		
e	Meat is the food that is rich in iron.	X		
f	Meat is not a good source of zinc.		X	
g	If a child does not eat enough vitamin A rich food, child will have low resistance to illness.	X		
h	If a child does not eat enough vitamin A rich food, child will have eye disease.	X		
i	Eggs are rich in protein that is essential for healthy growth of child.	X		
j	Adding small amount of oil/butter will give extra energy for child's growth.	X		
k	Orange colored fruits and vegetables are rich in vitamin A.	X		

	3. Please tell me if the following statement is true or false. If you don't know, say don't know.			
	Statements	True	False	Don't know
a	After 6 months of age, feeding only breast milk is adequate to meet the child's needs.		X	
b	The consequence of malnutrition is more serious for a three-years-old child than for a child who is one year old.		X	
c	It is not possible to reverse the effects of malnutrition that happens in the first 2 years of life.	X		
d	At 7 months of age, babies are not ready to digest foods other than soft gruel.		X	
e	At 9 months, babies are not ready to digest eggs.		X	
f	An adult person needs to feed a young child rather than having an older brother/sister feed the young child.	X		
g	At 7 months babies are not ready to digest thick porridge. Only thin porridge should be given.		X	
h	At 7 months babies do not need fruits in their diet.		X	
i	In addition to normal feeding, children should be fed often—whenever they are hungry.	X		
j	Children should be fed snacks between the meals.	X		
k	Children should be fed animal foods such as egg and meat as often as possible.	X		

4. For a child 12 up to 24 months of age, how much complementary food should be given per day? 1=3 full coffee cups of food (porridge) and one snack, 2=2 full coffee cups of food (porridge) and three snacks, 3=4 full coffee cups of food (porridge) and 1 to 2 snacks, 99=don't know	Answer: 3

5. The quality of complementary food can be improved by [Multiple responses possible) [Do not read the options] 1=Replacing water used to make porridge with milk, 2=Adding a small amount of oil or butter to porridge, 3=Adding mashed vegetables and animal products such as meat and fish 4=None of the above, 96=Other, specify, 99=I don't know	Answer:

	6. Please tell me if the following statement is true or false. If you don't know, say don't know.			
	Statements	True	False	Don't know
a	When a child is sick, child doesn't have appetite, so there is no need to give solid food. Child will eat when they recover from illness.		X	
b	Cooking large amount of foods to consume for a longer period of time is not a problem.		X	
c	Using clean water for cooking is important.	X		
d	Mixing different types of cereals and legumes to make porridge powder will increase child's nutritional status.	X		
e	It is no problem for child to share foods from the family plate.		X	
f	If child refuse to eat, parents should force the child to eat more.		X	
g	Parents should help the child to eat.	X		
h	Child's older siblings should be responsible for feeding the child.		X	

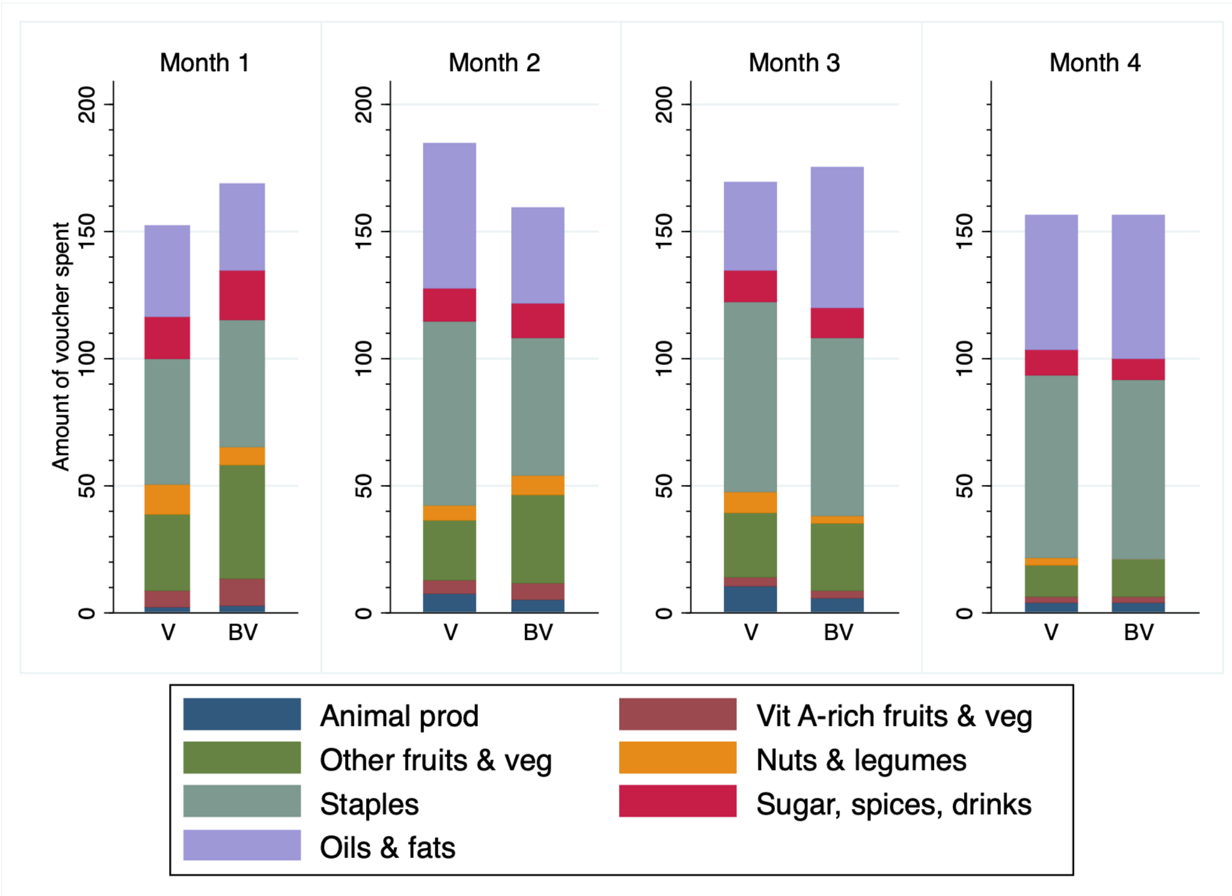
7. Please look at these two pictures of porridges. Which one do you think should be given to a young child at 10 months of age? *(Show the images/pictures of thick and watery/thin porridges and tick one of the options here below depending on the respondent answer.)* 1=Thin watery porridge, 2=Thick porridge, 99=Don't know **Support material: porridges** 1.  2. 	2

8. Do you know any ways to encourage young children to eat? *[Ask open question] [Multiple answers possible] [Do not read the options]* 1=Giving them attention during meals, talk to them, make meal times happy times 2=Clap hands 3=Make funny faces/play/laugh 4=Demonstrate opening your own mouth very wide/modelling how to eat 5=Say encouraging words 6=Draw the child's attention 96=Other, specify 99=Don't know	

Figure A6: Voucher Redemption Patterns Over Time (During Intervention)

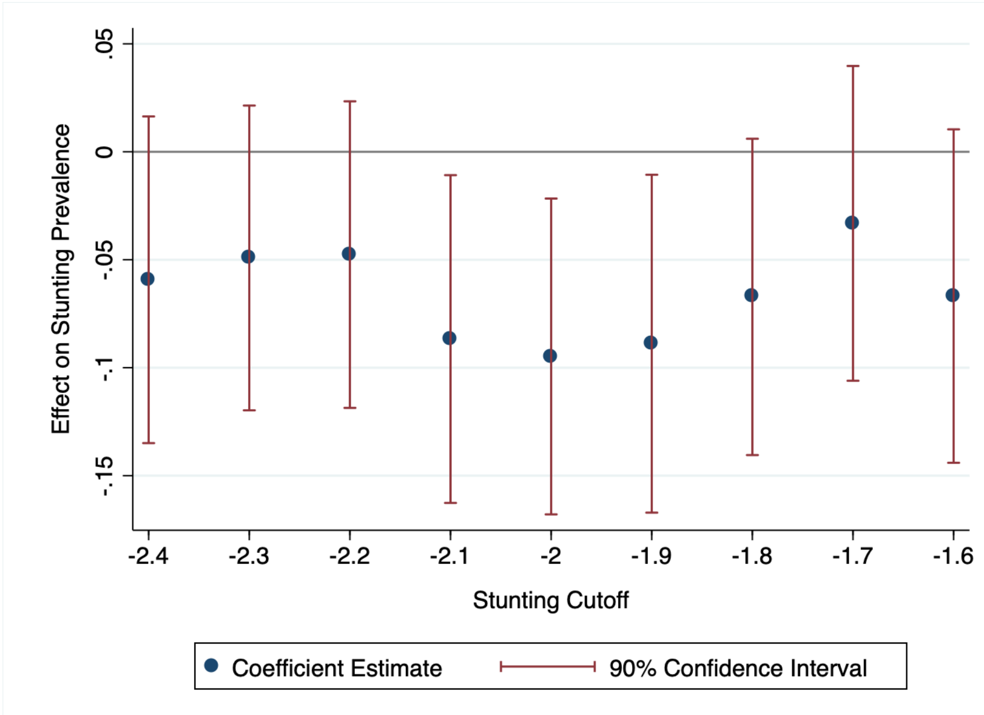
Note: This figure shows total amount of vouchers spent per week over time on average across both BCC and $BCC + Voucher$ groups, using voucher purchase administrative data. This includes households with zero voucher expenditures. The horizontal axis ranges from week 1 to 16. Bars are grouped in 4 weeks, indicating each month.

Figure A7: Voucher Redemption Patterns Over Time by Treatment and Food Group (During Intervention)



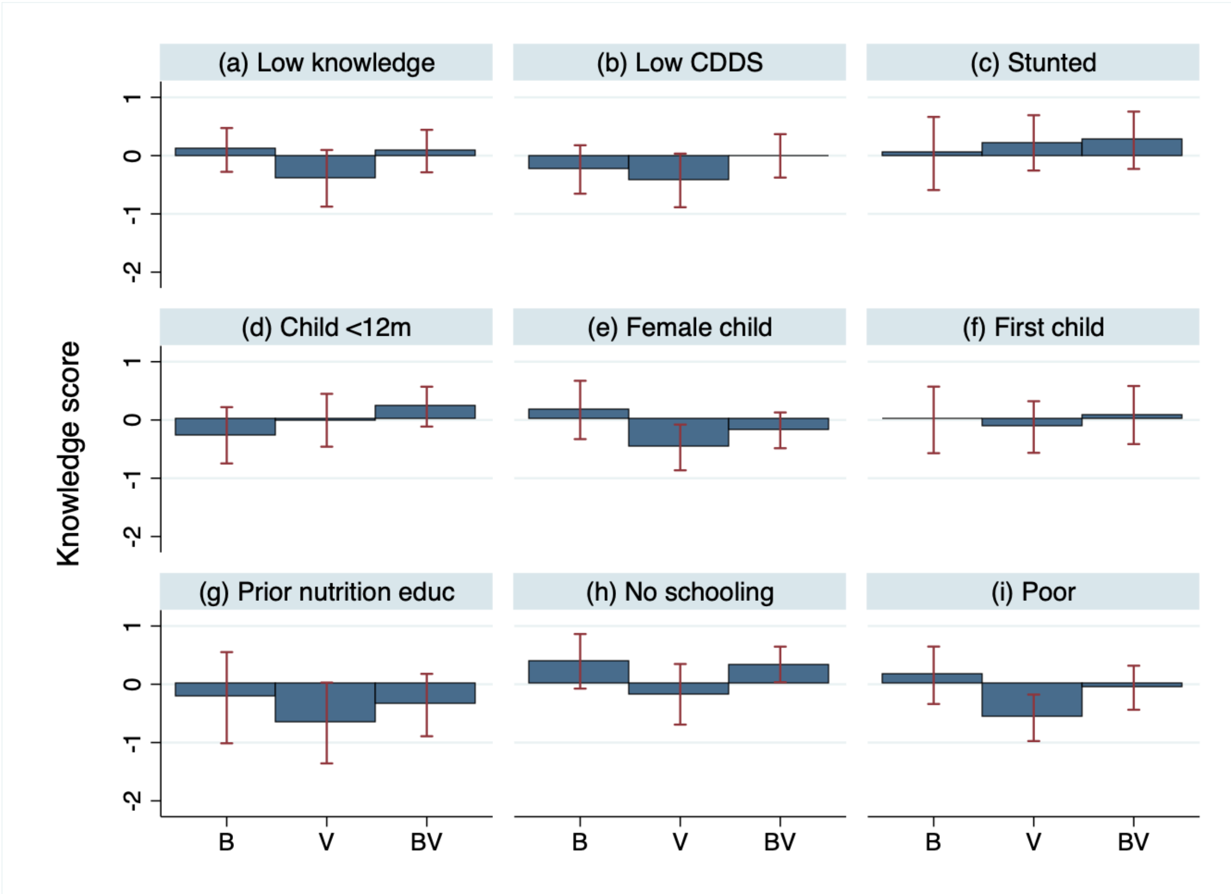
Note: This figure shows monthly voucher expenditures by food group and by treatment groups from month 1 (weeks 1-4) to month 4 (weeks 13-16), using voucher purchase administrative data. This includes households with zero voucher expenditures. V=Voucher, BV=BCC+Voucher.

Figure A8: Effects of $BCC + Voucher$ on Stunting Prevalence by various Cutoffs



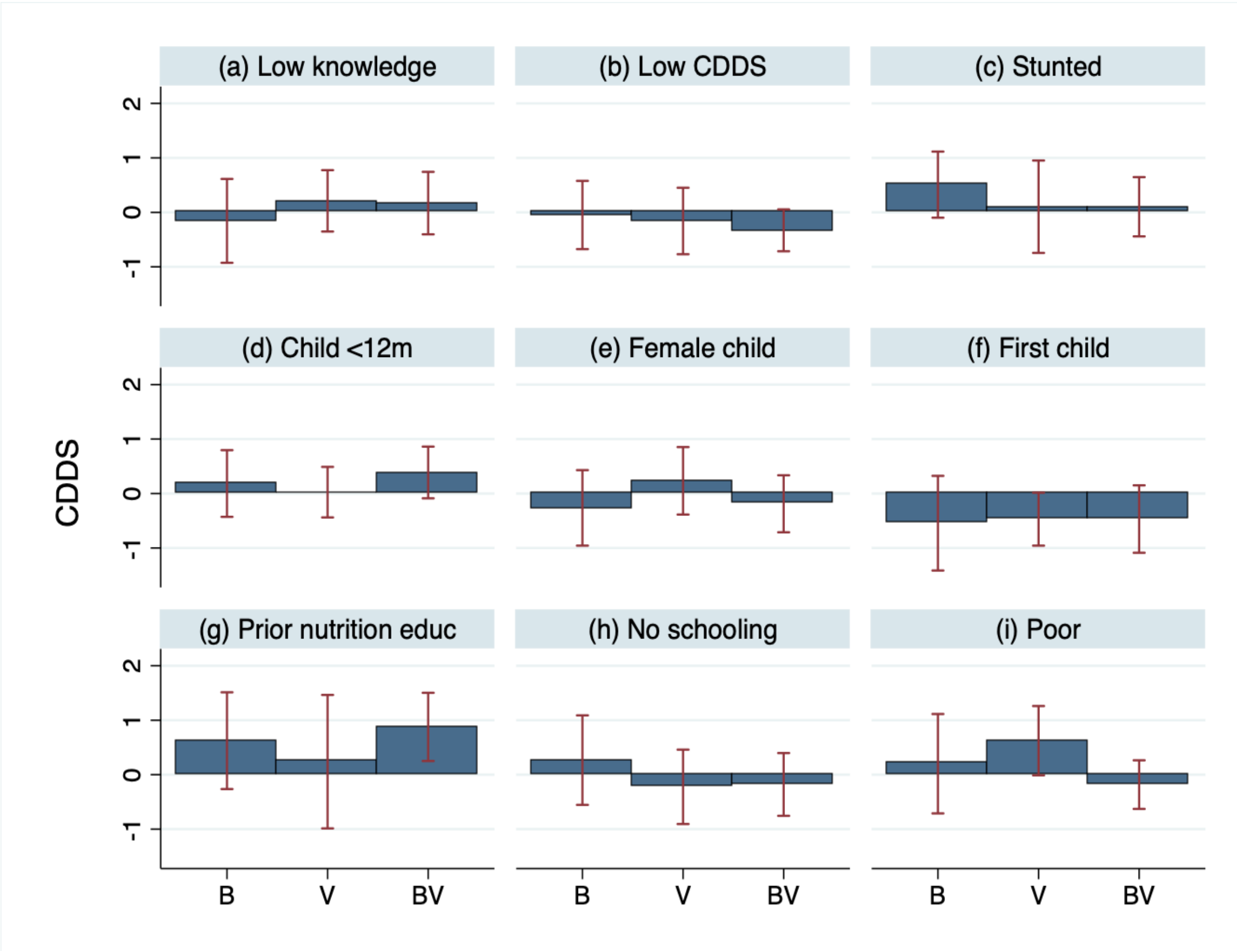
Note: This figure presents the effects of $BCC + Voucher$ on stunting prevalence (vertical axis), varying the stunting cutoff between -2.4 and -1.6 in increments of 0.1 (horizontal axis). The blue dots represent the coefficient estimate and the red vertical lines are the 90% confidence intervals. The gray horizontal line represents zero effect.

Figure A9: Heterogeneous Effects on Knowledge



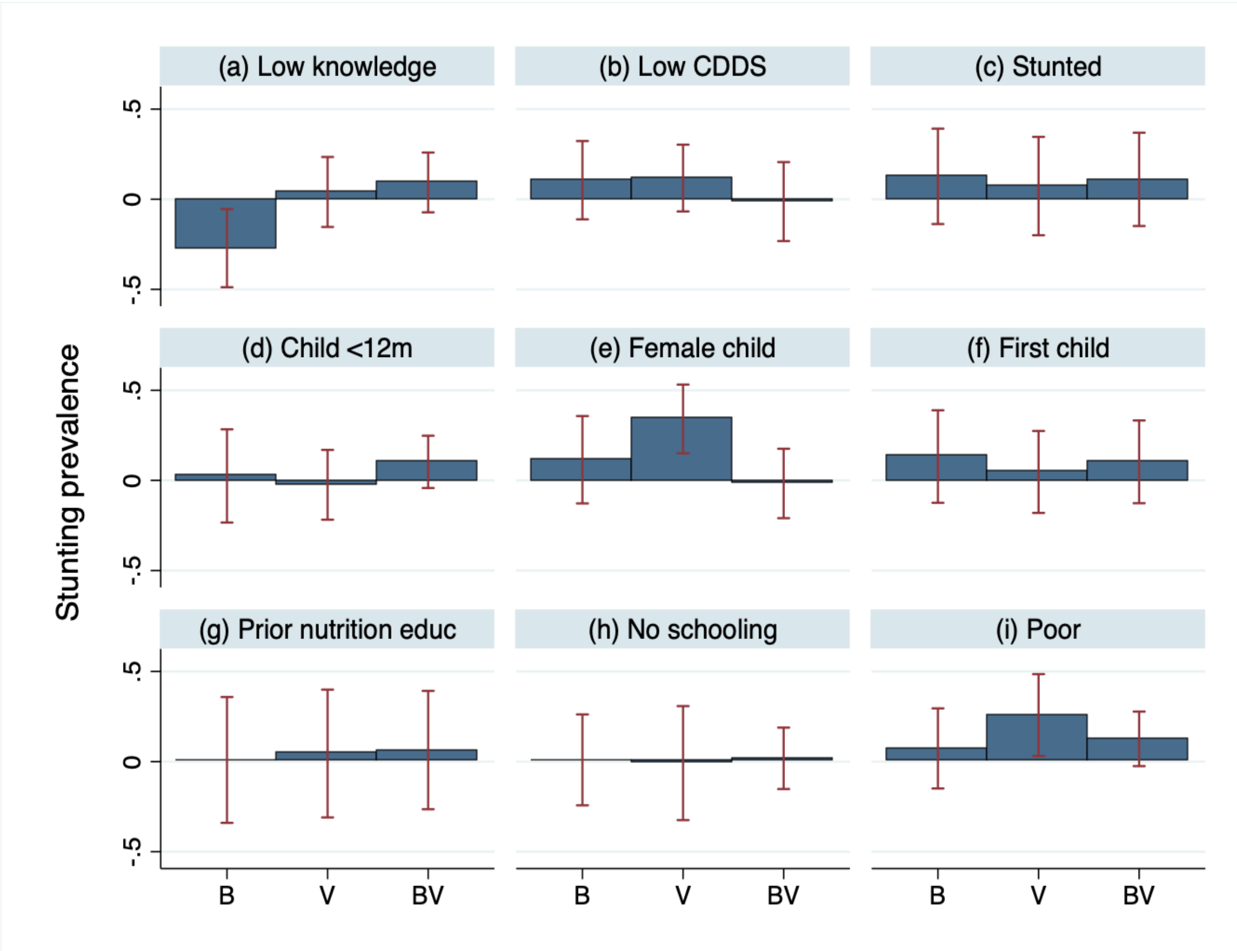
Note: This figure shows heterogeneous treatment effects on mothers' nutritional knowledge score (standardized) by a set of baseline outcomes which include: (a) knowledge score lower than the median, (b) child dietary diversity score (CDDS) 2 or less food groups, (c) child stunted at baseline, (d) child age below 12 months, (e) female child, (f) first child (new mother), (g) mother had prior exposure to nutrition education, (h) mother had no formal schooling, and (i) asset index below the median (poor). The bar graphs represent coefficient estimates of the interaction term between treatment and baseline characteristic of interest. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher.

Figure A10: Heterogeneous Effects on CDDS



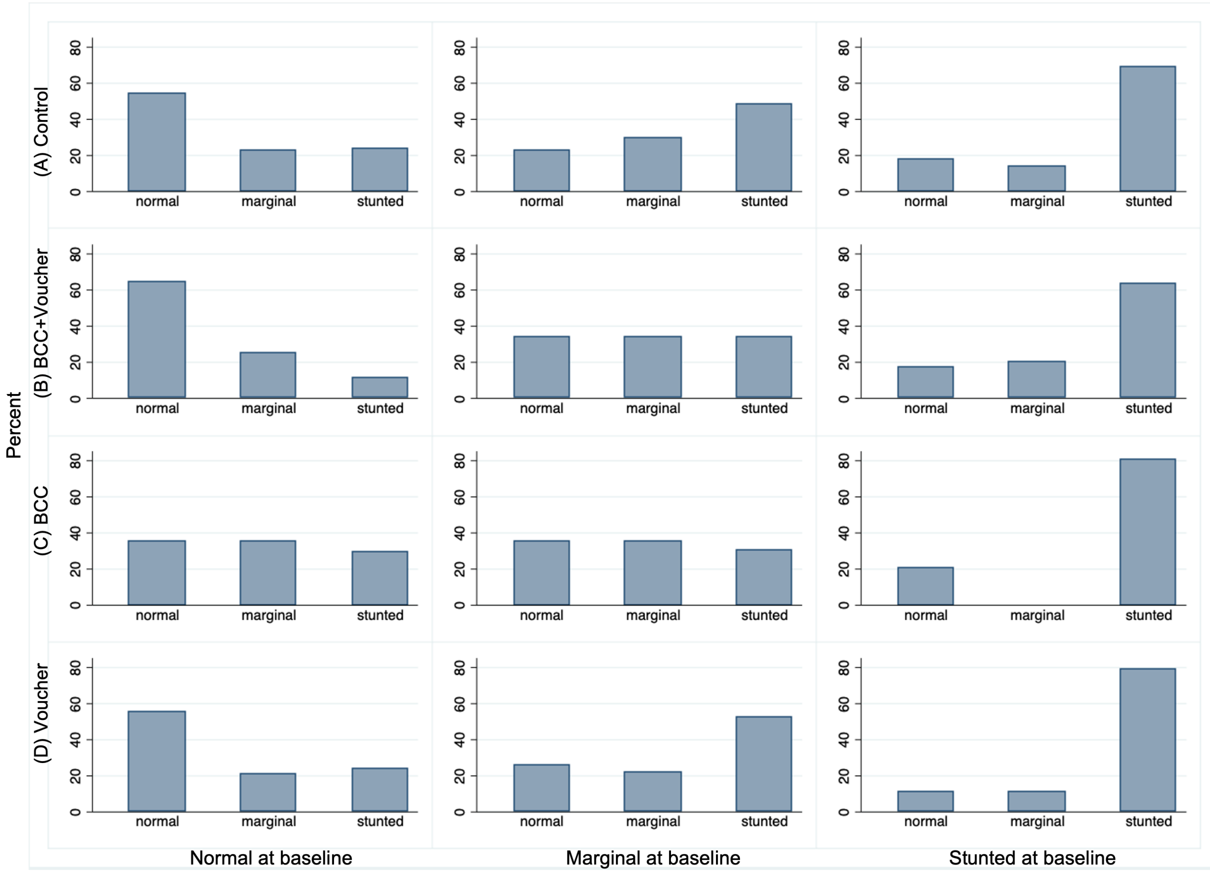
Note: This figure shows heterogeneous treatment effects on mothers' nutritional knowledge score (standardized) by a set of baseline outcomes which include: (a) knowledge score lower than the median, (b) child dietary diversity score (CDDS) 2 or less food groups, (c) child stunted at baseline, (d) child age below 12 months, (e) female child, (f) first child (new mother), (g) mother had prior exposure to nutrition education, (h) mother had no formal schooling, and (i) asset index below the median (poor). The bar graphs represent coefficient estimates of the interaction term between treatment and baseline characteristic of interest. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher.

Figure A11: Heterogeneous Effects on Stunting Prevalence



Note: This figure shows heterogeneous treatment effects on mothers' nutritional knowledge score (standardized) by a set of baseline outcomes which include: (a) knowledge score lower than the median, (b) child dietary diversity score (CDDS) 2 or less food groups, (c) child stunted at baseline, (d) child age below 12 months, (e) female child, (f) first child (new mother), (g) mother had prior exposure to nutrition education, (h) mother had no formal schooling, and (i) asset index below the median (poor). The bar graphs represent coefficient estimates of the interaction term between treatment and baseline characteristic of interest. The red vertical lines indicate 95% confidence intervals. B=BCC, V=Voucher, BV=BCC+Voucher.

Figure A12: Stunting Prevalence at Follow-up by Study Arm and Stunting Status at Baseline



Note: The bar graphs represent mean stunting prevalence by study arm and by stunting status at baseline categorized into three groups: Stunted (HAZ<-2), Marginal (-2≤HAZ<-1), and Normal (HAZ≥-1). Panels A, B, C, and D show the proportion of each category in the BCC, Voucher, BCC+Voucher, and control groups, respectively. In each panel, the first, second, and third columns present descriptives for the Normal, Marginal, and Stunted groups at baseline, respectively.

Table A1: Effects on BCC Attendance and Mother IYCF Knowledge by Topic

	IYCF Topics:					
	Animal source foods	Vitamin A-rich fruits & veg.	Malnutrition & care	Feeding quantity, frequency, thickness	Age of intro-duction	Hygiene
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Attendance rate by topic						
BCC (B)	0.687***	0.604***	0.729***	0.761***	0.653***	0.953***
	(0.029)	(0.040)	(0.054)	(0.028)	(0.024)	(0.022)
Voucher (V)	-0.009	-0.014	-0.005	-0.000	-0.001	-0.001
	(0.011)	(0.021)	(0.017)	(0.010)	(0.006)	(0.012)
BCC & Voucher (BV)	0.714***	0.657***	0.715***	0.773***	0.777***	0.802***
	(0.024)	(0.043)	(0.026)	(0.017)	(0.019)	(0.034)
Observations	637	637	637	637	637	637
R-squared	0.825	0.731	0.747	0.866	0.819	0.830
P-value: B=BV	0.466	0.329	0.836	0.715	0.000	0.000
Panel B. Knowledge score by topic						
BCC (B)	0.358***	0.385***	0.353***	0.198**	0.312***	0.038
	(0.134)	(0.085)	(0.118)	(0.091)	(0.096)	(0.154)
	[0.033]	[0.001]	[0.011]	[0.036]	[0.004]	[0.800]
	{0.026}	{0.003}	{0.004}	{0.085}	{0.018}	{0.808}
Voucher (V)	0.028	0.096	0.096	0.013	0.012	0.015
	(0.124)	(0.104)	(0.160)	(0.113)	(0.096)	(0.118)
	[0.827]	[0.406]	[0.588]	[0.900]	[0.904]	[0.911]
	{0.864}	{0.373}	{0.494}	{0.912}	{0.916}	{0.910}
BCC & Voucher (BV)	0.282**	0.308***	0.343***	0.256***	0.211**	0.051
	(0.109)	(0.091)	(0.081)	(0.084)	(0.091)	(0.102)
	[0.015]	[0.004]	[0.000]	[0.002]	[0.046]	[0.643]
	{0.061}	{0.015}	{0.000}	{0.051}	{0.111}	{0.675}
Observations	584	584	584	584	584	584
R-squared	0.080	0.074	0.083	0.072	0.108	0.071
P-value: B=V	0.034	0.010	0.166	0.110	0.002	0.890
P-value: B=BV	0.608	0.430	0.937	0.565	0.277	0.944
P-value: V=BV	0.076	0.060	0.137	0.044	0.041	0.796

Note: This table reports results on BCC attendance rate and mothers' IYCF knowledge score (standardized) by IYCF topic. Panel A uses administrative data and compares BCC attendance rates with the control group where the control and the voucher group's attendance rates are set to zero. Panel B uses survey data on mothers' IYCF knowledge. All estimations control for a standard set of control variables. Panel B additionally controls for the baseline outcome. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last row in Panel A and the last three rows in Panel B report p-values from F-tests of coefficient equality between treatment groups. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table A2: Effects on Child-feeding Practices Using First Difference

	CDDS	Minimum acceptable diet	Minimum dietary diversity	Minimum meal frequency	ASTE
	(1)	(2)	(3)	(4)	(5)
BCC (B)	0.591*	0.027	0.015	-0.007	0.020
	(0.264)	(0.063)	(0.076)	(0.081)	(0.024)
	[0.051]	[0.692]	[0.862]	[0.922]	[0.427]
	{0.061}	{0.671}	{0.867}	{0.940}	{0.428}
Voucher (V)	0.236	0.005	-0.003	-0.023	0.004
	(0.218)	(0.055)	(0.072)	(0.085)	(0.018)
	[0.290]	[0.930]	[0.967]	[0.780]	[0.849]
	{0.443}	{0.940}	{0.969}	{0.799}	{0.896}
BCC & Voucher	0.800**	0.128**	0.166*	0.049	0.061**
(BV)	(0.240)	(0.045)	(0.063)	(0.084)	(0.020)
	[0.026]	[0.015]	[0.055]	[0.601]	[0.011]
	{0.014}	{0.044}	{0.054}	{0.600}	{0.033}
Observations	583	580	583	529	2,275
R-squared	0.265	0.077	0.127	0.050	0.047
Control group mean	0.618	0.008	0.107	0.033	0.000
P-value: B=V	0.178	0.752	0.836	0.870	0.471
P-value: B=BV	0.452	0.103	0.057	0.582	0.099
P-value: V=BV	0.023	0.035	0.038	0.482	0.005
P-value: B+V=BV	0.941	0.262	0.170	0.558	0.237

Note: This table reports results on child dietary diversity score (CDDS), minimum acceptable diet standard, minimum dietary diversity, and minimum meal frequency, collected after intervention completion (see section 4.2 for outcome definition). Column 5 reports average standardized treatment effect (ASTE) across all outcomes in columns 1-4. All estimations use the first difference model and include a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** bootstrap $p<0.01$, ** bootstrap $p<0.05$, * bootstrap $p<0.1$.

Table A3: Effects on Other Child-feeding Measures

	Number of times breastfed yesterday	Number of times ate solid or semi-solid food yesterday	Perceived relative diet quality
	(1)	(2)	(3)
BCC (B)	0.198	0.126	0.037
	(0.222)	(0.218)	(0.027)
	[0.397]	[0.546]	[0.197]
	{0.408}	{0.556}	{0.299}
Voucher (V)	-0.256	0.303*	0.052**
	(0.242)	(0.145)	(0.025)
	[0.330]	[0.055]	[0.046]
	{0.286}	{0.123}	{0.144}
BCC & Voucher (BV)	-0.193	0.495**	0.077***
	(0.306)	(0.189)	(0.023)
	[0.627]	[0.023]	[0.003]
	{0.541}	{0.054}	{0.050}
Observations	578	580	584
R-squared	0.170	0.062	0.053
Control group mean	4.686	2.672	0.905
P-value: B=V	0.100	0.376	0.544
P-value: B=BV	0.253	0.142	0.119
P-value: V=BV	0.850	0.304	0.262
P-value: B+V=BV	0.742	0.825	0.735

Note: This table reports results on number of times breastfed yesterday, number of times ate solid or semi-solid food yesterday, and mothers' perception of their children's relative dietary quantity and quality. All estimations include the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** bootstrap $p<0.01$, ** bootstrap $p<0.05$, * bootstrap $p<0.1$.

Table A4: Effects on Household Food Consumption

	FCS	Whether household ate in the last week:									
		BCC-emphasized food groups					Not emphasized				
		Meat & poultry	Milk & milk prod.	Eggs	Vitamin A-rich fruits & veg.	ASTE	Nuts & legumes	Other fruits & veg.	Staples	Oils & fats	Sugar & spices
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
BCC (B)	5.446***	0.147*	0.088**	0.005	-0.049	0.028	-0.036*	-0.013	0.013*	0.016*	-0.004
	(1.672)	(0.070)	(0.038)	(0.064)	(0.050)	(0.015)	(0.019)	(0.015)	(0.007)	(0.009)	(0.012)
	[0.002]	[0.074]	[0.033]	[0.956]	[0.379]	[0.101]	[0.083]	[0.469]	[0.088]	[0.078]	[0.729]
	{0.007}	{0.044}	{0.058}	{0.951}	{0.442}	{0.066}	{0.157}	{0.435}	{0.239}	{0.246}	{0.932}
Voucher (V)	1.750	0.070	0.089**	-0.002	0.020	0.023	-0.003	-0.019	-0.006	0.003	-0.007
	(2.154)	(0.067)	(0.035)	(0.064)	(0.056)	(0.013)	(0.027)	(0.011)	(0.016)	(0.010)	(0.011)
	[0.470]	[0.335]	[0.031]	[0.981]	[0.735]	[0.136]	[0.923]	[0.170]	[0.757]	[0.814]	[0.729]
	{0.425}	{0.338}	{0.058}	{0.984}	{0.758}	{0.121}	{0.925}	{0.176}	{0.687}	{0.843}	{0.670}
BCC & Voucher	5.658***	0.149**	0.094**	0.213***	0.187***	0.071***	0.011	-0.014	0.005	0.003	0.003
(BV)	(1.632)	(0.060)	(0.039)	(0.050)	(0.059)	(0.014)	(0.026)	(0.011)	(0.011)	(0.013)	(0.004)
	[0.007]	[0.030]	[0.029]	[0.002]	[0.002]	[0.000]	[0.696]	[0.222]	[0.674]	[0.815]	[0.411]
	{0.019}	{0.053}	{0.059}	{0.009}	{0.013}	{0.000}	{0.700}	{0.301}	{0.679}	{0.821}	{0.601}
Observations	583	583	583	583	583	2,915	583	583	583	583	583
R-squared	0.218	0.201	0.144	0.203	0.245	0.157	0.061	0.064	0.055	0.047	0.051
Control mean	53.315	0.359	0.233	0.344	0.401	0.000	0.061	0.992	0.985	0.985	0.996
P-value: B=V	0.107	0.377	0.970	0.929	0.255	0.758	0.218	0.714	0.197	0.151	0.865
P-value: B=BV	0.906	0.971	0.872	0.002	0.000	0.007	0.094	0.932	0.421	0.249	0.467
P-value: V=BV	0.096	0.300	0.905	0.001	0.007	0.001	0.689	0.737	0.519	0.965	0.377
P-value: B+V=BV	0.594	0.494	0.131	0.018	0.007	0.292	0.222	0.430	0.887	0.254	0.397

Note: This table reports results on household food consumption score (FCS) and household food consumption by food group. Outcomes in Columns 2-11 indicate whether the household ate any food item from the food group. Column 6 reports average standardized treatment effect (ASTE) across outcomes in Columns 2-5 which are the food groups emphasized in the BCC program. All estimations control for the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** bootstrap $p<0.01$, ** bootstrap $p<0.05$, * bootstrap $p<0.1$.

Table A5: Effects on Household Expenditures

	Total food expenditure	Amount spent per capita in the last week:									
		BCC-emphasized food groups					Not emphasized				
		Meat and fish	Milk and milk products	Eggs	Vitamin A-rich fruits & veg.	ASTE	Other fruits & veg.	Nuts and legumes	Starchy staples	Oils and fats	Sugars, drinks, spices
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
BCC (B)	13.324	9.662**	-0.858	-0.170	0.194	0.015	1.866	3.473**	0.988	-0.297	-1.379
	(10.675)	(4.212)	(1.226)	(0.242)	(0.253)	(0.012)	(1.025)	(1.259)	(6.151)	(1.152)	(2.707)
	[0.293]	[0.044]	[0.537]	[0.502]	[0.503]	[0.300]	[0.112]	[0.026]	[0.888]	[0.850]	[0.620]
	{0.298}	{0.024}	{0.545}	{0.539}	{0.488}	{0.307}	{0.045}	{0.005}	{0.895}	{0.790}	{0.628}
Voucher (V)	14.690	12.669**	0.176	0.176	-0.205	0.020	0.281	0.171	-2.408	1.196	2.230
	(12.226)	(5.118)	(1.846)	(0.407)	(0.221)	(0.017)	(0.645)	(1.106)	(6.713)	(1.483)	(2.358)
	[0.268]	[0.024]	[0.931]	[0.740]	[0.370]	[0.321]	[0.681]	[0.895]	[0.746]	[0.475]	[0.344]
	{0.304}	{0.003}	{0.937}	{0.597}	{0.438}	{0.212}	{0.839}	{0.882}	{0.792}	{0.392}	{0.381}
BCC & Voucher (BV)	14.848	7.494*	1.418	0.651*	0.987***	0.052***	1.039	0.325	-2.386	1.040	3.643**
	(10.303)	(3.652)	(1.329)	(0.331)	(0.267)	(0.013)	(0.612)	(1.106)	(6.768)	(0.939)	(1.662)
	[0.187]	[0.085]	[0.313]	[0.081]	[0.006]		[0.102]	[0.777]	[0.758]	[0.347]	[0.029]
	{0.306}	{0.072}	{0.346}	{0.126}	{0.011}	{0.004}	{0.164}	{0.796}	{0.673}	{0.924}	{0.121}
Observations	583	583	583	583	583	2,332	583	583	583	583	583
R-squared	0.232	0.100	0.111	0.103	0.155	0.078	0.255	0.100	0.172	0.062	0.126
Control group mean	81.008	13.003	4.303	0.960	0.769	0.000	6.659	3.001	30.824	5.797	15.759
P-value: B=V	0.920	0.618	0.608	0.420	0.145	0.755	0.125	0.032	0.617	0.391	0.230
P-value: B=BV	0.900	0.636	0.119	0.016	0.009	0.010	0.462	0.035	0.624	0.329	0.066
P-value: V=BV	0.990	0.345	0.537	0.277	0.000	0.084	0.347	0.910	0.997	0.921	0.554
P-value: B+V=BV	0.440	0.030	0.360	0.184	0.008	0.414	0.428	0.071	0.915	0.944	0.459

Note: This table reports results on weekly household food expenditures in total and by food group. Each outcome indicates the amount spent by household in the last week per capita in Ethiopian Birr. Column 6 reports average standardized treatment effect (ASTE) across outcomes in Columns 2-5 which are the food groups emphasized in the BCC program. All estimations control for the baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** bootstrap $p<0.01$, ** bootstrap $p<0.05$, * bootstrap $p<0.1$.

Table A6: Effects on Child Physical Growth Using First Difference

	Stunted (1)	HAZ (2)	Wasted (3)	WHZ (4)
BCC (B)	0.085	0.033	0.029	-0.024
	(0.074)	(0.207)	(0.046)	(0.213)
	[0.277]	[0.895]	[0.577]	[0.918]
	{0.266}	{0.866}	{0.564}	{0.914}
Voucher (V)	0.077	-0.189	0.054	-0.391
	(0.074)	(0.186)	(0.041)	(0.279)
	[0.352]	[0.337]	[0.246]	[0.210]
	{0.312}	{0.337}	{0.247}	{0.169}
BCC & Voucher (BV)	-0.113**	0.234	0.067*	-0.183
	(0.044)	(0.170)	(0.039)	(0.190)
	[0.030]	[0.299]	[0.098]	[0.333]
	{0.126}	{0.261}	{0.171}	{0.488}
Observations	486	486	481	481
R-squared	0.109	0.078	0.062	0.068
Control group mean	0.127	-0.362	-0.005	-0.054
P-value: B=V	0.929	0.363	0.654	0.248
P-value: B=BV	0.010	0.376	0.488	0.481
P-value: V=BV	0.013	0.041	0.781	0.475
P-value: B+V=BV	0.012	0.177	0.824	0.507

Note: This table reports results on stunting prevalence, height-for-age Z scores (HAZ), wasting prevalence, and weight-for-height Z scores (WHZ), collected after intervention completion (see section 4.2 for outcome definition). All estimations use the first difference model and include a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. The last four rows report p-values from F-tests of coefficient equality between treatment groups. *** bootstrap p<0.01, ** bootstrap p<0.05, * bootstrap p<0.1.

Table A7: Effects on Child Physical Growth by Stunting Status at Baseline

	Stunted (1)	HAZ (2)	Wasted (3)	WHZ (4)
Panel A. Not stunted at baseline				
BCC (B)	0.063	0.059	-0.024	0.229
	(0.071)	(0.205)	(0.031)	(0.190)
	[0.400]	[0.772]	[0.438]	[0.252]
	{0.306}	{0.771}	{0.516}	{0.172}
Voucher (V)	0.037	-0.156	0.064	-0.302*
	(0.078)	(0.186)	(0.041)	(0.162)
	[0.707]	[0.466]	[0.187]	[0.075]
	{0.594}	{0.449}	{0.019}	{0.051}
BCC & Voucher (BV)	-0.112	0.289	0.077**	-0.159
	(0.059)	(0.199)	(0.030)	(0.183)
	[0.144]	[0.259]	[0.023]	[0.428]
	{0.122}	{0.239}	{0.018}	{0.502}
Observations	354	354	349	349
R-squared	0.104	0.219	0.052	0.109
Control group mean	0.282	-1.140	0.061	0.118
Panel B. Stunted at baseline				
BCC (B)	0.199	-0.396	-0.082	0.641
	(0.129)	(0.326)	(0.082)	(0.471)
	[0.188]	[0.279]	[0.341]	[0.216]
	{0.248}	{0.323}	{0.490}	{0.188}
Voucher (V)	0.170	-0.385	-0.198**	0.844
	(0.133)	(0.338)	(0.086)	(0.460)
	[0.271]	[0.293]	[0.045]	[0.121]
	{0.365}	{0.330}	{0.264}	{0.172}
BCC & Voucher (BV)	-0.015	-0.099	-0.142*	0.170
	(0.114)	(0.304)	(0.073)	(0.342)
	[0.890]	[0.767]	[0.061]	[0.621]
	{0.922}	{0.780}	{0.234}	{0.688}
Observations	132	132	126	126
R-squared	0.131	0.158	0.216	0.146
Control group mean	0.690	-2.320	0.123	-0.146

Note: This table reports results on stunting prevalence, height-for-age Z scores (HAZ), wasting prevalence, and weight-for-height Z scores (WHZ) collected after intervention completion. Panel A reports results for children not stunted at baseline and Panel B for those stunted at baseline. All estimations include baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. *** bootstrap p<0.01, ** bootstrap p<0.05, * bootstrap p<0.1.

Table A8: Effects on Child-feeding Practices by Stunting Status at Baseline

	CDDS	MAD	MDD	MMF	ASTE
	(1)	(2)	(3)	(4)	(5)
Panel A. Not stunted at baseline					
BCC (B)	0.204	0.057	0.022	0.065	0.028
	(0.188)	(0.049)	(0.062)	(0.082)	(0.022)
	[0.300]	[0.257]	[0.732]	[0.462]	[0.250]
	{0.381}	{0.181}	{0.881}	{0.395}	{0.291}
Voucher (V)	0.004	-0.012	-0.046	0.037	-0.005
	(0.213)	(0.038)	(0.068)	(0.068)	(0.025)
	[0.984]	[0.782]	[0.534]	[0.602]	[0.829]
	{0.805}	{0.781}	{0.277}	{0.383}	{0.752}
BCC & Voucher (BV)	0.582**	0.153**	0.137	0.129*	0.084***
	(0.194)	(0.051)	(0.068)	(0.068)	(0.025)
	[0.046]	[0.026]	[0.179]	[0.075]	[0.005]
	{0.009}	{0.012}	{0.071}	{0.095}	{0.000}
Observations	408	407	408	367	1,590
R-squared	0.131	0.135	0.119	0.078	0.079
Control group mean	3.147	0.136	0.353	0.527	0.000
Panel B. Stunted at baseline					
BCC (B)	1.015***	0.128*	0.252***	0.074	0.103***
	(0.282)	(0.063)	(0.074)	(0.120)	(0.027)
	[0.007]	[0.087]	[0.008]	[0.547]	[0.003]
	{0.045}	{0.066}	{0.173}	{0.609}	{0.067}
Voucher (V)	0.281	0.063	0.167	-0.070	0.035
	(0.346)	(0.078)	(0.106)	(0.149)	(0.031)
	[0.467]	[0.448]	[0.146]	[0.639]	[0.354]
	{0.881}	{0.477}	{0.654}	{0.977}	{0.749}
BCC & Voucher (BV)	0.509	0.134**	0.251**	0.105	0.090**
	(0.298)	(0.060)	(0.088)	(0.120)	(0.026)
	[0.124]	[0.046]	[0.016]	[0.417]	[0.014]
	{0.132}	{0.046}	{0.028}	{0.376}	{0.007}
Observations	155	155	155	147	612
R-squared	0.190	0.189	0.216	0.147	0.109
Control group mean	2.738	0.092	0.215	0.569	0.000

Note: This table reports results on child dietary diversity score (CDDS), minimum acceptable diet (MAD), minimum dietary diversity (MDD), and minimum meal frequency (MMF) collected after intervention completion. Column 5 reports average standardized treatment effect (ASTE) across all outcomes in columns 1-4. Panel A reports results for children not stunted at baseline and Panel B for those stunted at baseline. All estimations include baseline outcome and a standard set of control variables. Robust standard errors clustered at the unit of randomization, the village level, in parentheses. Wild-cluster bootstrap p-values in square brackets. Randomization inference p-values in curly brackets. *** bootstrap p<0.01, ** bootstrap p<0.05, * bootstrap p<0.1.

Appendix B BCC Curriculum

BCC in general is the strategic use of communication to promote positive health outcomes, based on proven theories and models of behavior change. BCC employs a systematic process beginning with formative research and behavior analysis, followed by communication planning, implementation, and monitoring and evaluation. Audiences are carefully segmented, messages and materials are pre-tested, and mass media (which include radio, television, billboards, print material, internet), interpersonal channels (such as client-provider interaction, group presentations), and community mobilization are used to achieve defined behavioral objectives (MEASURE Evaluation 2018).

The curriculum of the BCC program developed for this study is based on the Alive & Thrive's BCC program implemented in Ethiopia. Alive & Thrive is an initiative to save lives, prevent illness, and ensure healthy growth and development through the promotion and support of optimal maternal nutrition, breastfeeding, and complementary feeding practices. Alive & Thrive has worked in Ethiopia since late 2009 to address widespread and limited recognition of the long-term consequences of stunting and find ways to reach mothers (Thrive 2018).

The BCC intervention is designed as a 16-week-long educational program to cover all of the key topics in IYCF while maximizing cost-effectiveness (Table B1). Each session ended with an action plan the mothers agreed upon, and the following session reviewed and discussed past week's action plans. In addition, the BCC participants also received a small handbook containing a summary of IYCF contents and weekly action plans based on contents learned each week, and a self-check diary.

Table B1: Mother IYCF BCC Curriculum

Week	Contents	Week	Contents
1	Introduction	9	A: Frequency & amount of complementary food B: Eating schedule & discussion
2	Dietary diversity and weekly diet schedule	10	Recipe and cooking demonstration
3	When to start complementary feeding	11	Responsive feeding
4	Thickness & consistency of complementary food	12	Feeding during illness
5	Role play & discussion	13	Role play & discussion
6	Food variety-iron, proteins from meat	14	Hygienic preparation & storage of food
7	A: Enrichment of complementary food B: Household food processing strategy	15	Group discussion & review
8	Role play & discussion	16	Testimonials & ceremony

Appendix C Proof of Conceptual Model

Building on the literature using child health production function (Del Boca et al. 2014; Fitzsimons et al. 2016; Gronau 1986; Rosenzweig and Schultze 1983), we conceptualize that households are concerned about adult consumption (X) and children's health (H). For simplicity we assume that each household has one adult (mother) and one child. The household maximizes the following utility function by choosing X, C_1, and C_2 simultaneously:

$$\max_{X,C_1,C_2} U(X,H) = (1-\alpha)log(X) + \alpha log(H)$$

$$s.t.\ \ X + C_1 + C_2 \leq Y \tag{C1}$$

where $U(.,.)$ captures the utility from adult consumption utility and child health (H). The representative household consumes three goods in the economy. The first good is X, which denotes adult's food consumption. Children's consumption is composed of two composite goods: C_1 and C_2. C_1 refers to staple food, the type of food that is predominantly fed to children by mothers. On the other hand, C_2 is meat, fruit, and vegetables that are often overlooked by mothers. α refers to relative weight of perceived health of the child compared to mothers' food consumption, and Y is income.

We define the health production function of the child as follows:

$$H = C_1^{\gamma_1} C_2^{\gamma_2} \tag{C2}$$

where $C_i = (\int_0^1 c^i(z)^{\frac{\theta-1}{\theta}}\, dz)^{\frac{\theta}{\theta-1}}$, and C_i is a continuum of differentiated goods $c(z)$ indexed in $z \in [0,1]$. The elasticity of substitution, θ, is larger than 1. We assume that $\gamma_1 + \gamma_2 = 1$ and $\gamma_1 \leq \gamma_2$. While the true health production function is given, mothers have different perceptions about the child production function prior to the intervention because they lack nutritional information or have misbelief about optimal child-feeding. Therefore, their *perceived* child health production is:

$$\hat{H} = C_1^{\delta_1} C_2^{\delta_2} \tag{C3}$$

where $\delta_1 + \delta_2 = 1$ and $\delta_1 > \delta_2$, representing that mothers put more weight on c_1. We assume that $\delta_1 > \gamma_1$, which essentially captures our assumption that mothers mistakenly place too much weight on c_1.

Using the *perceived* child health production function in Equation (C3), the mother's optimization problem is:

$$\max_{X,C_1,C_2} U(X,H) = (1-\alpha)log(X) + \alpha(\delta_1 log(C_1) + \delta_2 log(C_2))$$

$$s.t.\;\; X + C_1 + C_2 = Y + V \tag{C4}$$

where V denotes the voucher amount. We assume that the voucher amount is inframarginal—i.e., it is less than the total amount the household spends on food. Solving the above household problem algebraically, we get the following result:

$$X^* = (1-\alpha)(Y+V)$$

$$C_1^* = \alpha\delta_1(Y+V)$$

$$C_2^* = \alpha\delta_2(Y+V)$$

$$H^* = \{\alpha\delta_1(Y+V)\}^{\gamma_1}\{\alpha\delta_2(Y+V)\}^{\gamma_2} = \alpha\delta_1^{\gamma_1}\delta_2^{\gamma_2}(Y+V)$$

The results show that mothers always allocate $(1-\alpha)(Y+V)$ to their own consumption. The remaining $\alpha(Y+V)$ goes to children's consumption, which is distributed to the consumption of C_1 and C_2 with weights δ_1 and δ_2, respectively. Note that in the no intervention case, $V=0$ holds, whereas, in the $Voucher$ only intervention case, $V>0$ holds.

To further explore the effects of BCC and $BCC + Voucher$, we hypothesize that the effects of BCC are two-folds: 1) mothers care relatively more about children's food consumption than their own, and 2) mothers gain knowledge on optimal child-feeding—i.e., revealing the true health production function. The first effect is captured by adjusting the coefficient α in Equation (C4) to β where $\alpha < \beta$. This first effect captures the substitution effect from mothers' consumption to children's consumption. As for the second effect, mothers update prior belief about health production function coefficients, δ_1 and δ_2, to the true coefficients, γ_1 and γ_2, respectively. Combining these two effects, the optimization problem of the mother with BCC can be re-written as:

$$U(X,H) = (1-\beta)log(X) + \beta(\gamma_1 log(C_1) + \gamma_2 log(C_2))$$

$$s.t.\;\; X + C_1 + C_2 = Y + V \tag{C5}$$

Solving the above problem algebraically, we obtain the following result:

$$X^* = (1-\beta)(Y+V)$$

$$C_1^* = \beta\gamma_1(Y+V)$$

$$C_2^* = \beta\gamma_2(Y+V)$$

$$H^* = \{\beta\gamma_1(Y+V)\}^{\gamma_1}\{\beta\gamma_2(Y+V)\}^{\gamma_2} = \beta\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}(Y+V)$$

In the *BCC* only case, $V = 0$ holds. In the *BCC+Voucher* case, $V > 0$. Summarizing the results, the algebraic representations of optimal goods for each case is presented in Table C1.

Table C1: Summary of Results for Each Case

Variables	Control	BCC	Voucher	BCC+Voucher
Adult Food X	$(1-\alpha)Y$	$(1-\beta)Y$	$(1-\alpha)(Y+V)$	$(1-\beta)(Y+V)$
Child Food C_1	$\alpha\delta_1 Y$	$\beta\gamma_1 Y$	$\alpha\delta_1(Y+V)$	$\beta\gamma_1(Y+V)$
Child Food C_2	$\alpha\delta_2 Y$	$\beta\gamma_2 Y$	$\alpha\delta_2(Y+V)$	$\beta\gamma_2(Y+V)$
Health H	$\alpha\delta_1^{\gamma_1}\delta_2^{\gamma_2}Y$	$\beta\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}Y$	$\alpha\delta_1^{\gamma_1}\delta_2^{\gamma_2}(Y+V)$	$\beta\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}(Y+V)$
ΔC_2	0	$(\beta\gamma_2-\alpha\delta_2)Y$	$\alpha\delta_2 V$	$\beta\gamma_2(Y+V)-\alpha\delta_2 Y$
ΔH	0	$(\beta\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}-\alpha\delta_1^{\gamma_1}\delta_2^{\gamma_2})Y$	$\alpha\delta_1^{\gamma_1}\delta_2^{\gamma_2}V$	$\beta\gamma_1^{\gamma_1}\gamma_2^{\gamma_2}(Y+V)-\alpha\delta_1^{\gamma_1}\delta_2^{\gamma_2}Y$

Note: ΔC_2 and ΔH denote the difference in C_2 and H, respectively, compared to the control group. We assume that $\alpha < \beta$, $V > 0$, $\delta_1 > \delta_2$, $\delta_1 > \gamma_1$, and $\delta_2 < \gamma_2$.

To examine whether there is complementarity between BCC and vouchers in improving child-feeding practices, we use ΔC_2 as a measure of child diet diversity. Interpreting C_2 as a composite good of food items emphasized in the BCC program, we can understand C_2 as the CDDS measure. Analytically, the difference between child-feeding improvements in *BCC+Voucher* and the sum of child-feeding improvements in *BCC* and *Voucher* is as follows:

$$\Delta C_2^{BV} - (\Delta C_2^B + \Delta C_2^V) = (\beta\gamma_2 - \alpha\delta_2)V > 0 \tag{C6}$$

where ΔC_2^{BV}, ΔC_2^B, and ΔC_2^V denote the impact on child consumption of nutritious food in the $BCC + Voucher$, BCC, and $Voucher$ groups compared to control, respectively.

In addition, to examine complementarity between BCC and vouchers in improving child health, we similarly take the difference between child health improvements in *BCC+Voucher* and the sum of child health improvements in *BCC* and *Voucher* as follows:

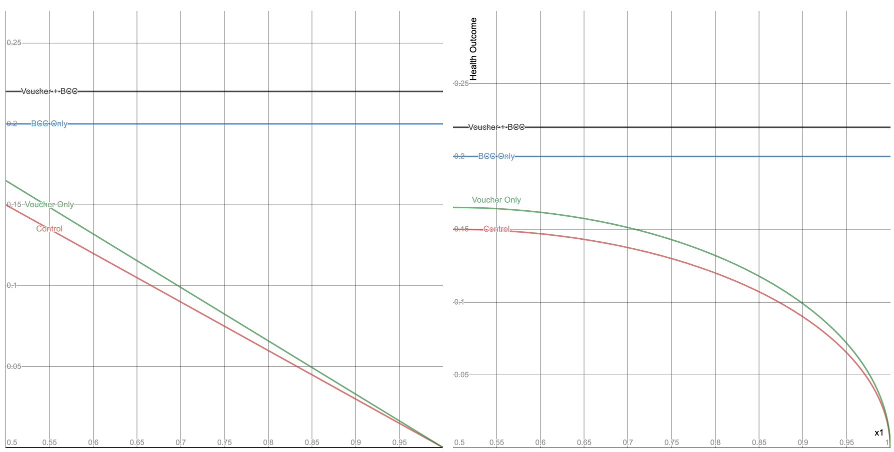
$$\Delta H^{BV} - (\Delta H^B + \Delta H^V) = (\beta\gamma_1^{\gamma_1}\gamma_2^{\gamma_2} - \alpha\delta_1^{\gamma_1}\delta_2^{\gamma_2})V > 0 \tag{C7}$$

where ΔH^{BV}, ΔH^{B}, and ΔH^{V} denote the impact on child health outcomes in the $BCC + Voucher$, BCC, and $Voucher$ groups compared to control, respectively. It follows that BCC and vouchers are complementary in improving both child-feeding practices and child health, driven by greater resource allocation to child consumption ($\alpha < \beta$) and improved nutritional knowledge ($\delta_2 < \gamma_2$).

Graphical and Numerical Representations

Without loss of generality, we assume that $\gamma_1 = 0.5$ hereafter. Fixing $\alpha = 0.3$ and $\beta = 0.4$, we identify the effect of δ_1, the perceived weight of child food C_1, on the outcomes. The graph below presents the changes in child health and child-feeding outcomes if we vary δ_1 from 0.5 to 1.00 in the control, *BCC*, *Voucher*, and *BCC+Voucher* groups. $Y = 1$ and $V = 0.1$ is also assumed. The left panel shows the effect on CDDS, while right child health outcome. These graphs show that the greater the gap between the initially perceived and

Figure C1: Effects of varying δ_1

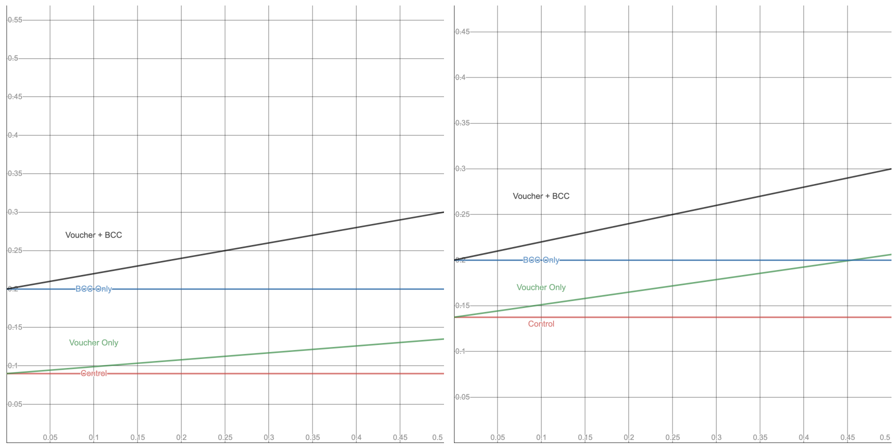


the true child health production functions, the greater the effect size compared to the control group for *BCC* and *BCC+Voucher* groups. Figure C1 also show that complementarity in child-feeding and child health increase with δ_1, the perceived importance of less nutritious food groups such as staples.

We also examine the effects of varying V, the size of the voucher. Fixing $\alpha = 0.3$ and $\beta = 0.4$, $\gamma_1 = 0.5$, $\delta_1 = 0.7$, and $Y = 1$, the graph below presents the effect of varying V from 0 to 0.8. The left panel shows the effect on CDDS, while right child health outcome.

The graphs in Figure C2 show that the greater the voucher size as a proportion of the household's income, the greater the effect size against the control for *Voucher* and

Figure C2: Effects of varying V



BCC+Voucher groups. While the voucher size is fixed in our study, the voucher as a proportion of the household's income vary by the size of household's income. Hence, the results above can be interpreted as greater the effect size of *Voucher* and *BCC+Voucher* as well as complementarity for low-income households.

We also provide a numerical example using the parameters $\alpha = 0.3$, $\beta = 0.4$, $V = 0.1$, $Y = 1$, $\delta_1 = 0.75$, and $\gamma_1 = 0.5$.

Table C2: Numerical Example

Variables	Control	BCC	Voucher	BCC+Voucher
Adult Food X	0.700	0.600	0.770	0.660
Child Food C_1	0.225	0.200	0.248	0.220
Child Food C_2	0.075	0.200	0.083	0.220
Health H	0.130	0.200	0.143	0.220
$\%\Delta C_2$	0	166.67%	10%	193.33%
$\%\Delta H$	0	53.85%	10%	69.23%

The results on ΔC_2 and ΔH further confirm that *BCC+Voucher* has the largest impact on diet diversity and child health—greater than that of *BCC* and *Voucher* combined—with *BCC* having a moderate impact and *Voucher* having the smallest impact (Table C2).

Appendix D Cost-effectivenss Analysis

This section presents the cost-effectiveness analysis of the *BCC+Voucher* intervention on stunting reduction. This analysis is conducted for the *BCC+Voucher* group only because the intent-to-treat impact of the interventions on stunting is statistically significant for this intervention only. The outcomes for this analysis include cost per case of stunting averted and per disability-adjusted life years (DALY) averted.[1] The number of cases of stunting averted by the intervention relative to the control group were calculated using the associated point estimate reported in Table D1, and the total population of children in intervention and control villages.

Program cost data were extracted from AFF accounting ledgers to assess costs associated with the *BCC+Voucher* intervention. Costs were assessed over the implementation period of the *BCC+Voucher* intervention covering beneficiary selection and 4 months of the program implementation. Start-up costs and intervention piloting costs and costs incurred outside of the intervention period were not assessed. All costs are expressed in 2018 US dollars. Costs were not adjusted for inflation due to interventions lasting less than one year.

Total costs of the *BCC+Voucher* intervention is presented in Table A8, including program costs and costs borne by program participants. The *BCC+Voucher* intervention with 154 program participants had a total cost of US\$11,712 with 84% of the total cost attributed to program operational and transfer costs and 16% borne by program participants. Costs of implementing the 16-week-long BCC program were US\$3,063 with most costs related to personnel. Implementation costs for the voucher program, including the transfers, were US\$5,544. The actual transfer amount accounted for 82% of the voucher program costs.

The direct and indirect costs borne by *BCC+Voucher* participants include transportation fares and time participating in the BCC sessions.[2] Average transportation cost to BCC

[1]DALY is an index used to measure health outcomes which consists of years of life lost (YLL) and years lived with disability (YLD). We assume that the age at onset of stunting to be the average children age at follow-up, i.e., 18 months, and the duration of illness to be lifelong. Life-expectancy was calculated as a sex-weighted average using local life expectancy of males (63.7) and females (67.3) (WHO 2018). The disability weight for stunting (0.0002) was taken from the Global Burden of Disease study published in 1990 (Murray and Lopez 1996) and retained in subsequent studies. The disability weight for death is 1.000. To calculate YLL, expected mortality was calculated using the under 5-year mortality rate (UNICEF 2018) adjusted to exclude mortality in children aged less than 1 year (You et al. 2015) and mortality due to stunting (McDonald et al. 2013). YLL and YLD components were calculated and summed to estimate the number of DALY averted for *BCC+Voucher*.

[2]We did not consider travel and time costs for voucher distribution because voucher was distributed at the participants' closest market to which she would have traveled regardless of voucher distribution for personal

session locations was US$0.36 per roundtrip for *BCC+Voucher* participants which was multiplied by 16 BCC sessions. Average time cost for participating in the BCC sessions was US$0.21 per hour for *BCC+Voucher* participants, multiplied by 16 hourly BCC sessions. Based on household surveys, we estimated that a roundtrip from house to BCC session took one hour. No cost was incurred for the control group.

On average, the total cost of *BCC+Voucher* per household was US$76 and approximately US$15 per month. This cost is considerably lower than other similar integrated nutrition programs.[3] The cost per case of stunting averted by *BCC+Voucher* was US$795 and cost per DALY was US$265 which is considered highly cost-effective in WHO standards (WHO 2014).

grocery shopping. When the participant didn't obtain the vouchers from the market, voucher staff visited their household.

[3]For example, Rwanda's Gikuriro, an integrated nutrition program funded by the USAID and implemented by Catholic Relief Services, cost US$142 per household and find no effect on stunting (McIntosh and Zeitlin 2018).

Table D1: *BCC+Voucher* Cost-effectiveness Analysis

	Amount (USD)	Amount per household (USD)	% of Total
Panel A. BCC			
Personnel	1,110	7	9.5%
Community workers	640	4	5.5%
Personnel transportation	419	3	3.6%
Training materials	614	4	5.2%
Other program costs	281	2	2.4%
BCC subtotal	3,063	20	26.2%
Panel B. Voucher			
Transfer amount	5,544	36	47.3%
Personnel	430	3	3.7%
Personnel transportation	479	3	4.1%
Community workers	274	2	2.3%
Voucher subtotal	6,727	44	57.4%
Panel C. Beneficiary cost			
Transportation	887	6	7.6%
Time	1,035	7	8.8%
Beneficiary cost subtotal	1,922	12	16.4%
TOTAL	11,712	76	
Total cost per household		US$ 76	
Decrease in prevalence of stunting		9.5%	
Cases of stunting averted		15	
Cost per case of stunting averted		US$ 795	
DALY averted		44	
Cost per DALY averted		US$ 265	